THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

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VOL. IV.—FOURTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMANS, GREEN, READER, AND DYER; SIMPKIN, MARSHALL, AND CO.; KENT AND CO.; BAILLIÈRE, REGENT STREET, AND PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES AND SMITH, DUBLIN: AND ASHER, BERLIN.

1869.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. IV.

[FOURTH SERIES.]

NUMBER XIX.

NUMBER XX.

NUMBER XXI.

NUMBER XXII.

NUMBER XXIII.

NUMBER XXIV.

PLATES IN VOL. IV.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

"   per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 19. JULY 1869.

I.—*A Descriptive Account of four Subspherous Sponges, Arabian and British, with General Observations.* By H. J. Carter, F.R.S. &c.

[Plates I. & II.]

The Subspherous Sponges, like potatoes in appearance, analogous also in form to the Lycoperdons, the large Sphæriæ, and the tuberose Fungi, are not unfrequently present among the exuviæ of the sea-shore, where, after having been freed from their original attachments, and drifting in a living state about the bottom of the sea for awhile, they are at last landed by the waves.

Having specimens of two species, which I found on the south-east coast of Arabia (one of which was gathered alive), and of two others found on the beach at Budleigh-Salterton (also alive), I resolved, for the sake of direct information, to examine them respectively; and bringing to my aid Dr. Johnston's work on the British Sponges (1842), and Dr. Bowerbank's papers on the Spongiadæ, published successively in 1862 and 1864 by the Royal and Ray Societies, I found so much still left untold that I further resolved to draw each of these sponges themselves, and, placing their elementary parts beside them respectively, to write a simple description also of each (that is, confining myself as much as possible to familiar terms in our own language), and to follow the whole by ge-

neral observations showing how far I agree and how far differ from the remarks of my predecessors on this portion of the Spongiadæ.

Two of the species which I have figured and described are new, viz. the Arabian ones; and the other two are common to our own shores, but hitherto very inadequately represented. Each contrasts in most respects strongly with the other, and all four brought together in this way seem to me well fitted to convey a good idea of the principal as well as peculiar features of the subspherous Spongiadæ respectively.

My object has not been to present a mere description which might serve for a handbook, but to give an elaborate account, with illustrations, of four of the most characteristic species of the division, to correct to a certain extent what appear to be the errors of others, and thus to record, to the best of my ability, descriptions and observations which might be relied upon for future classification.

In these descriptions I shall as much as possible avoid the word "tissue;" for such is only shadowed forth in the sarcode of the sponge, and, however much apparent in its fresh state, more or less subsides into a glue-like mass on drying, when tissue in the higher developments for the most part puts forth its most definite, prominent, peculiar, and persistent characters. The tissues and the structures of the sarcode, whatever they may be, are, for the most part, as it were *in embryo*; and we have nothing to do with the naming of objects, in a scientific point of view, until they are unmistakably defined. Hence such terms as ovaria, membrane, œsophagus, pyloric valve, &c., in respect to the sponge, had better for the present be omitted, whatever their application hereafter may prove worth when such parts in the sponge are undeniably identified.

In the following descriptions, also, it must not be expected that I have given the whole history of the British species, their habitat, locale, &c.; this must be sought for in the works to which I have alluded, my desire being chiefly to contrast four prominent species among the subspherous sponges, two of which appear to have been undescribed, and the other two unsatisfactorily illustrated.

The measurements (of course approximative) are chiefly given in the explanations of the plates, to avoid confusion in the text, and units indicating so many 1800ths of an inch or fractions of the same (unless otherwise mentioned) have been employed, by which the relative proportion of the objects in size may be seen at once, and the real size readily computed if necessary; while the illustrations of the sponges themselves,

although drawn after nature as much as the subject would permit, are less for effect than for efficiency, the microscopist often having, in his delineations, to aim at that which an artist would not tolerate nor could supply.

Tethya arabica, mihi.

Pl. I. figs. 1–8, and Pl. II. figs. 19 & 20.

Globular and free, or hemispherical and fixed. Surface soft, hispid, reticulated, with the pores occupying the interstices, and projecting spicules the lines of reticulation, all more or less matted together by the dermal sarcode of the sponge. Large vents in more or less plurality, monticular. Internal structure radiated, rigid, compact, consisting of a corticular, a body-, and a nucleated portion. Corticular portion loose, ill-defined, consisting of tufts of spicules matted together by dermal sarcode. Body formed of sponge-substance supported on bundles of spicules overlapping each other and radiating from the nucleus to the circumference; the whole permeated by the excretory system of canals, which, branching and anastomosing throughout, finally terminate in the vents on the surface of the sponge. Fleshy portion of sponge-substance more or less charged with minute spherical bodies like gemmules. Nucleus globular, consisting of a more compact and dense condition of the spicules and sponge-substance of the body. Spicules of the surface all smooth and pointed, consisting for the most part of groups of bifid, trifid extended, and trifid recurved heads, supported on long delicate shafts respectively, mingled with the pointed ends of the stout spicules of the body. Spicule of the body straight, smooth, fusiform, pointed at each end, or not unfrequently with one end more or less abruptly terminated and round. *Minute*, thread-like, contorted spicules, semicircular and sigmoid, together with minute siliceous globules, abound throughout the sponge, but more particularly in the corticular portion; somewhat larger ones, of a semielliptical form, with single, pointed, incurved ends, and others of a like kind, whose shafts consist of three curves (of which the central is the largest), with trifid ends, webbed together like a waterfowl's foot, and bent inwards, are not uncommon in this sponge. Gemmules (?) numerous, white, spherical, in all sizes of development up to the matured or largest, which consists of a spheroidal cell filled with globules (?) of refractive matter; gemmule white, when viewed by direct light, but by transmitted light seen to be surrounded by an equally spherical transparent portion, or cell, densely charged with extremely minute, bacilliform spicular bodies.

Size variable, that of specimen figured 3 inches in its longest diameter. Colour:—corticular portion grey, body bright orange, nucleus pink.

Hab. South-east coast of Arabia, opposite the north-east end of the island of Masira. Free or fixed to the rocks along the shore.

Obs. I found several specimens of this sponge about the locality mentioned; some were floating or rolling about in the land-wash, and others fixed to the rocks—the latter with, and the former of course without, point of attachment. It is probable that those portions alone float which, having got out of the water for a little time, get some air in them, and that when this is extricated they again sink to the bottom. The sarcodal substance of this sponge is so rigid and contractile that, when alive, it can with difficulty be torn to pieces. Those on the rocks appeared to me to get more rigid in proportion as I tried to get them off, until at last I was obliged to apply my geological hammer and chisel to them. The forcible power of contractility here, as well as in *Tethya lyncurium*, which I shall presently describe, may partly account for the compact character of the sponge-substance after death, and the comparative absence of the excretory system of canals probably arising therefrom, in both these species. *T. arabica* very much resembles *T. cranium* of our own shores; but I found no gemmules in it, like those figured and described by Johnston and Bowerbank respectively as peculiar to the latter species; nor does the surface of the Arabian species agree with that of *T. cranium* figured in Johnston's 'British Sponges.' It appears nevertheless to be the representative of the latter on the south-east coast of Arabia.

In one small portion of the surface which I examined there happened to be several stoutish triradiate spicules, with their rays expanded in the corticular part, like those of *Geodia*—showing, by this occasional occurrence, how such characters may be present in species otherwise distinctly different.

On treatment with iodine, faint traces of starch made their appearance in the globular contents of certain little cells, but not of the gemmules, which turned amber-colour.

When dry, the surface of this sponge presents a glistening asbestiform appearance, from the number of delicate spicules which project beyond the dermal sarcode.

Geodia (*Cydonium*, Gray) *arabica*, mihi. Pl. I. figs. 9–16.

Globular, free or fixed. Surface hard, hispid, covered with a short hirsute dermal sarcode (where the latter is not abraded) densely charged with minute smooth spicules, beneath which

are a number of dimples or pores more or less regularly scattered over the whole sponge, with here and there larger ones, of the same appearance, which seem to be vents. Internal structure subradiated, cavernous, consisting of a cortex and body, but no nucleus. Cortex hard, compact, composed of a thin but firm layer of globular crystalloids, apparently in contact with each other, covered externally by the dermal sarcode mentioned, and internally in communication with the body, the dermal sarcode presenting minute apertures of communication between the exterior and interior of the sponge; and, where abraded, that portion only of this sarcode which is usually stretched across the pore in the form of a diaphragm with central circular aperture some distance below the surface. Body formed of sponge-substance supported on intercrossing stout spicules, which circumferentially run into a zone of radiating ones that support the cortex, and centrically into a denser condition, which is subnuclear; the whole permeated by an excretory system of wide canals, which, branching and anastomosing throughout, communicate to the body a cavernous subradiated structure, finally terminating in the vents on the surface of the sponge. Spicules of the dermal sarcode minute, smooth, slightly curved and pointed at each end. Globular crystalloids of the crust more or less elliptical, somewhat compressed vertically, and presenting an umbilicated depression on the proximal side; found in every part of the sponge, in all stages of development, but chiefly forming the crust. When young, consisting of a minute central point surrounded by a radiated mass of hair-like spicules, which, in advancing towards maturity, become conical externally and, giving place to a clear general crystallization of the centre or body internally, terminate at last on the surface in short, rough, club-shaped eminences and polygonal star-like facets (peculiar to the umbilicated depression and convexity respectively) separated from each other by shallow fissures. Spicules of the body large, smooth, fusiform, slightly curved and pointed at each end. Spicules of the zone supporting the crust all smooth and pointed; provided for the most part with trifid extended, trifid recurved, and triradiate heads, in the proportion of about eight of the two former to one of the latter, which in point of stoutness is more than double their size; all furnished with long pointed shafts, of which the stout triradiate one is by far the shortest, although the thickest. *Minute* stellate spicules found in every part of the structure, but most about the crust, inside and out, consisting of a variable number of smooth (?), straight rays, radiating from a central globule; also some few of a larger kind, in which the rays consist of a number of

short conical processes standing out vertically from a thick globular body. Size variable; that of the specimen figured 3 inches in diameter. Colour: grey on the surface, yellowish interiorly.

Hab. South-east coast of Arabia, opposite the north-east end of the island of Masira. Free at the bottom of the sea, whence it gets landed by the waves.

Obs. I have never found a living specimen of this sponge, or a specimen fixed to the rocks: my descriptions are taken from dried ones found on the sea-shore, whose shape nevertheless indicates their free or floating habit. Pieces of stone and coral, however, may be attached to this sponge almost sufficient to keep it stationary at the bottom of the sea; and in these instances it is observed that the crust is always continuous next to the foreign material, by which we learn that it must therefore have been the dermal sarcode outside the crust which attached them to the surface of the sponge. Of course the same remark applies to the condition under which portions of *G. arabica* would float or sink to the bottom as that on *T. arabica*, viz. the presence or absence of air in it.

This species is closely allied to *Geodia zetlandica* of our shores; and if hereafter it should be found that the dermal spicules of *G. arabica* are of the same kind as those which impart a like hirsute character to *G. zetlandica*, and that this character in the latter should be owing more to their presence than to the "projection of the body-spicules" (which in *G. arabica* are ten times as long as the dermal ones), then it is not improbable that both will have to be regarded as belonging to the same species. Stellate spicules also abound in the dermal sarcode, but they are subsidiary; they are no more numerous there than the stellate spicules which we shall presently see in the dermal sarcode of *Pachymatisma Johnstonia*, where a fusiform, rough, and not the stellate form will be found to be the dermal spicule in particular. Like the latter, whose surface, when fresh, is of a grey colour, from the translucent state of the globular crystalloids and sponge-tissue when soaked in water, it consequently becomes chalky-white when dry; and probably, like *Pachymatisma* also, although subsequently free, is, in the early part of its history, fixed in some submarine locality.

On comparing the size of the pores and their distance apart in *G. arabica* with those in a fresh specimen of *Pachymatisma* (where they appear in other respects to be precisely alike), I find that the former are all much smaller and much nearer together than in the latter. But as they are much smaller and much nearer together in the dried than in the fresh speci-

mens of *Pachymatisma*, I infer that in the fresh state of *G. arabica* they would also have been much larger and much further apart than in the dried specimen. This difference in size and distance therefore arises from contraction; and allowance should be made for it in viewing the illustration, which is, of course, taken from a dried specimen.

On raising a portion of the crust of a specimen of *G. arabica*, and taking out a piece of the subjacent structure (viz. that just inside the trifid heads of the spicules of the zone), I find, by treatment with iodine, that it often contains many decided starch-granules, whose presence seems to indicate that they were developed there, and there in particular, since the part was never so exposed before I opened it, and no portions of the structure taken from other parts of the sponge have, under similar circumstances, presented any trace of an amylaceous deposit; nor have I ever been able to find any starch-granules in a corresponding position of the structure in *Pachymatisma Johnstonia*. The remark is therefore made for what it may prove worth hereafter.

Tethya (*Donatia*, Gray) *lyncurium*, Lam.

Pl. II. figs. 1–6.

Globular, almost spherical, fixed. Surface continuously uneven, wartlike, and rigid, except at the part of attachment, which is, of course, rough and torn; consisting of small, more or less circular lobes, with interangular depressions, the former presenting the broken ends of spicules, and the latter, in the recent state only, the pores and vents respectively of the sponge, which the cortex, owing to its powerfully contractile nature, closes to almost entire obliteration after death. Internal structure radiated, rigid, compact, consisting of a cortex, body, and nucleus. Cortex defined, thick, rigid, consisting of sponge-fibre interlacing at right angles the spicules of the body as the bundles of the latter pass through it, in an expanded form, to the surface; the whole so dense as to assume the appearance of fibro-cartilage; charged with two forms of stellate spicular bodies peculiar to the species. Body consisting of sponge-substance supported on stout bundles of spicules overlapping each other and radiating from the nucleus to the circumference; the whole permeated by the excretory system of canals, which, branching and anastomosing throughout, finally terminate in the vents on the surface of the sponge. Nucleus large, globular, consisting of sponge-fibre and spicules, all intercrossing and interwoven with each other so densely as, like the cortex, to present the appearance of fibro-cartilage. Spi-

cules of the body straight, smooth, fusiform subulate—that is, awl-shaped, with one end round; of different degrees of tenuity, but probably all subulate. Stellate spicules of two kinds, large and small or minute: large stellate spicule smooth, consisting of a clear globule of silex more or less covered with tubercular projections supporting a variable number of conical pointed rays, which are frequently more or less undulated, and sometimes bifurcated, at the extremity; situated chiefly at the union of the cortex with the body: *minute* stellate spicules consisting, in like manner, of a central globule, from which project a variable number of rough subspinous rays; found in abundance throughout the whole structure, particularly in the lines of the afferent or incurrent (?) canals, and the outer part of the cortex. Size of specimen figured about an inch in diameter when fresh. Colour dull sponge- or amber-yellow, most evident in the fleshy substance of the body.

Hab. England, Devon, Budleigh-Salterton beach. Marine, place of growth to me unknown.

Obs. About three years since, several of these were found on the beach at Budleigh-Salterton, having by some means been wrenched from their place of growth and thrown up (I think in the autumn) among other exuviæ. They were brought to me quite fresh on the same day that they were found; but their place of growth is to me as yet unknown. I could discover no gemmules or reproductive bodies in them like those observed in *Tethya arabica*; and the afferent and efferent canals can only be traced by placing a thin vertical section of the cortex (after having been compressed while drying) in balsam, when the minute stellate spicules almost alone mark their course, on account of the homogeneousness of the structure and plastic consistence of its elementary tissues through which they pass, and in which, on this account, they appear to exist as mere canalicular excavations. In short, the fibres of the cortex are so soft, plastic, and delicate, that on drying they all collapse into a common mass, in which individually they become indistinguishable.

It might be observed that the abundance of minute stellate spicules in the afferent canals are for the purpose of straining the water as it passes through them into the body of the sponge; but it must be first proved that they *are* in the afferent or incurrent, and not in the efferent canals, before this opinion can be held; and then it can only be conjectural.

Pachymatisma Johnstonia, Bowerbank. Pl. II. figs. 7–18.

Subglobular, tuberose. Surface hard, or covered with a soft dermal sarcode (where not abraded) densely charged with

minute rough spicules, beneath which are a number of pores more or less regularly scattered over the whole sponge, with here and there larger ones that appear to be vents. Internal structure dense, amorphous, without any appearance of radiation, consisting of a cortex and body only. Cortex hard, compact, composed of a thin but firm layer of globular crystalloids in juxtaposition, covered externally by the dermal sarcode mentioned, and internally in continuous contact with the body; pierced by conical or dimpled depressions called "pores," keeping up communication between the exterior and interior of the sponge through several microscopic apertures in the dermal sarcode opposite to them, when this sarcode has not been abraded, but where this has been the case presenting a diaphragm of it pierced by a circular aperture some distance below the surface*. Body formed of sponge-tissue supported on intercrossing spicules, which circumferentially run into a narrow zone of triradiate ones that support the crust, the whole permeated by the excretory system of canals, which, branching and anastomosing throughout, communicate to the body a cavernous structure, but not the least appearance of radiation; finally terminating in the vents at the surface of the sponge. Spicules of the dermal sarcode minute, fusiform, rough or subspinous. Globular crystalloids of the crust for the most part elliptical, elongate, somewhat compressed vertically, and presenting an umbilicated depression on the proximal side, found abundantly in every stage of development in every part of the sponge, but chiefly in the crust, where they are packed together like masonry, and sometimes equally so round the calibre of some of the excretory canals for nearly an inch of their course inwards. When young, consisting of a minute central point surrounded by a radiating mass of hair-like spicules, which, in advancing towards maturity, become conical externally and, giving place to a clear crystallization of the body internally, terminate on the surface in clavate rough extremities or polygonal star-like facets (according to their position in the umbilical depression or on the convex surface of the crystalloid), separated from each other by superficial fissures. Spicules of the body all smooth and slightly curved, cylindrical or fusiform, with simply rounded or inflated extremities. *Minute* stellate spicules abundantly dispersed in every part of the sponge, and consisting of a variable number of conical subspinous rays, radiating from a more or less conspicuous central point. Size of specimen figured about 1¾ inch in

* That this diaphragm is a portion of the dermal sarcode seems probable, from the occasional presence in it of the dermal spicule.

longest diameter when fresh. Colour light grey, becoming darker on contraction of the sponge after death.

Hab. England, Devon, Budleigh-Salterton beach. Marine, place of growth to me unknown.

Obs. I found three specimens of this sponge on the beach at Budleigh-Salterton in February last, the largest of which is about 3 inches in diameter. They did not present any pedicle of attachment, and therefore must have been free for some time previously. Sessile they are most probably at one time or other, and soon cement themselves through the dermal sarcode to loose stones or rocks when they are left in contact with them respectively. But they always fortify themselves with their crust first, which thus as constantly intervenes between the body and the foreign ingredient. It is the dermal sarcode which forms the bond of attachment. Two of the specimens were fresh and living when I found them on the beach; but of their original place of growth I am as yet ignorant. Sometimes, probably, such sponges are wrested from their places of attachment by the dredges or trawls of the fishermen as they pass over sandy bottoms, and, when thus loosened and brought to the boat, may not be thrown overboard until some air has got into them, when they float on the surface till this is extricated, but, afterwards sinking, may be drifted at last by under-currents to the shore.

It is to the microscopic apertures in the dermal sarcode covering the pores and their subjacent cavities that Dr. Bowerbank would apply the terms "pores" and "intermarginal cavities" respectively—points to which we will now more particularly direct our attention.

GENERAL OBSERVATIONS.

Pores and Oscules.

To understand these terms, it is necessary to consider them abstractedly. Thus the young *Spongilla* growing from the seed-like body may probably be taken as typical of the whole. It consists of many pores and one oscule. The former admit the particles of food to the sponge; and the undigested portions, having passed through its sarcodal substance (apparently in the same manner and as easily as the undigested particles in *Amœbæ* are passed through its body, viz. without cicatrix), find their way into the excretory system of canals which terminate in the latter or single oscule. And this system, multiplied over and over again as the mass increases in bulk, probably accounts for the great number of pores, together with the plurality of oscules presented by all the larger pieces of sponge.

Before the particles reach the pores, they pass through apertures in a delicate expansion of sarcode which, membrane-like, covers the *Spongilla*, which apertures (about 1-700th of an inch in diameter) are extemporized here and there in this expansion, or closed, as occasion may require. Again, the single oscule, which is supported on a tubular mammillary projection and passes through the sarcodal expansion, can also be closed or opened as required by the sponge.

But these apertures are situated in a substance which is too delicate and evanescent to last long under rough treatment; and hence the term "pores" has been used by naturalists for those superficial cavities which this sarcodal expansion covers in the more solid and durable parts of the sponge, viz. those which are evident to the unassisted eye. Hence the name "Porifera" applied to the class by Dr. Grant, the term "oscule" having only been used for the larger pore which is the opening of the excretory system of canals. "Vent" has also been applied to the latter, which, as regards function, is, of course, more suitable.

Thus Dr. Johnston, in his 'British Sponges,' p. 196, describes the surface of *Geodia zetlandica* as "dimpled in some places, with numerous pores placed pretty closely together, and large enough to be visible with the naked eye,"—to which Dr. Bowerbank (Brit. Sponges, vol. ii. p. 46) objects, stating that "These orifices are not the pores, but they are the intermarginal cavities which receive the minute streams from numerous pores situated immediately above and within a short distance of them; the true pores, perforating the dermal membrane, are too minute to be visible without the assistance of considerable microscopic power." Yet, in describing *Pachymatisma*, only seven pages further on (p. 53), the same author states:—"In the living condition the pores are not visible to the unassisted eye, but in the dried state they are very distinctly seen;" while at p. 110 of vol. i. we read:—"In *Pachymatisma Johnstonia*, Bowerbank, a British sponge closely allied to the genus *Geodia*, we find the dermal membrane perforated by innumerable pores, some as minute as $\frac{1}{1000}$ inch in diameter, while others attained the size of $\frac{1}{250}$ inch."

It is not difficult to see that there is some confusion here: viz. that in the latter quotation "pores" (ranging from $\frac{1}{1000}$ to $\frac{1}{250}$ inch in diameter), which certainly cannot be distinctly seen by the unassisted eye, are stated in the former quotation, although not visible to "the unassisted eye" in the living condition, to be "very distinctly" so in the dried state.

In this dilemma I prefer the prescriptive meaning given to the pores by Dr. Johnston, and as such shall continue to apply

it, leaving the "pores" and "intermarginal cavities" of Dr. Bowerbank for subsequent explanation.

In my description of the "Ultimate Structure of *Spongilla*" (Annals, 1857, vol. xx. p. 21), I have shown that the membrane-like sarcodal expansion in which Dr. Bowerbank's "pores" are situated, is composed, like the rest of the animal, of a congeries of polymorphic sponge-cells, and that thus these "pores" can be extemporized or closed in any part of this structure that occasion may require. Hence Dr. Bowerbank's term of "dermal membrane" does not give an adequate idea of the real nature of this development. Indeed it would be out of place, as it is out of character, to expect in the ever-changing, polymorphic, sarcodal substance of these primitive animals anything to which the term "membrane," as it is used in anatomical description for the higher animals, could be applied; and it was on this account that, in the 'Annals' of 1856, I proposed the term "pellicula" for the surface of sarcodal structures, this having previously been suggested by Mohl for the consolidated surface of material which has no distinct enclosing membrane, and by Dujardin, who likens it to the film which occurs over "flour paste or glue when allowed to cool in the air."

I am aware that I have misapplied the term "membrane" myself, as regards *Spongilla*, in the paper to which I have alluded; but that is no reason why I should repeat it here. In this paper, also, I have used the term "apertures" for the extemporized holes in the sarcodal expansion covering the sponge, and the terms "afferent" and "efferent" for the incurrent and excurrent systems of canals respectively which are hollowed out in the parenchyma of the body, and I shall continue to use these terms under the same signification. It should, however, be remembered that while the efferent canals form a distinctly arboritic system, the afferent ones appear to be only passages of intercommunication between the exterior of the sponge and its areolar or vacuolar cavities, and between the areolar cavities themselves. For the more ultimate structure of the parenchyma in *Spongilla*, see 'Annals,' *l. c.*

From the "pores" (that is to say, my "apertures") let us follow Dr. Bowerbank on to his "intermarginal cavities," which, at p. 101, Brit. Spong. vol. i., are thus described:— "They are in form very like a bell the top of which has been truncated. They are situated in the inner portion of the dermal crust, the large end of the cavity being the distal, and the smaller end the proximal one. The open mouth or distal end of the cavity is not immediately beneath the dermal membrane. There is an intervening stratum of membranes and

sarcode, of about two-fifths the entire thickness of the dermal crust, which is permeated by numerous minute canals, which convey the water inhaled by the pores to the expanded distal extremity of the cavity. The proximal end is closed by a stout membranous valvular diaphragm, which the animal has the power of opening or closing at its pleasure."

Now, the result of my dissection of this structure, both in *Geodia* and *Pachymatisma*, being somewhat different and more elaborate, it will be better to describe it in my own words; and using the term "pores" in the sense of Dr. Johnston, viz. for the dimpled depressions of the surface, it is perfectly evident that they are the orifices of hourglass-shaped openings in the crust, whose constricted portion is situated about midway between the external and internal surfaces of the latter, as proved by their expanded portions on either side requiring to be scraped off for a better observation of the constricted one.

These hourglass-shaped openings are lined throughout with a thin film of sarcode, which, in the constricted portion, still further reduces the diameter of this part by extending itself across it in the form of a diaphragm provided with a central opening which is more or less spiral *inwards*, the outer part of the diaphragm being always *flat*. Moreover the spire, which commences in the aperture of the diaphragm, is sometimes prolonged inwards from it in the form of a spiral tube of four or five turns, which is again constricted in the centre and free at the *inner* extremity—thus dipping as it were into the inner portion of the hourglass cavity. (Pl. II. figs. 11, 12.)

Hence the aperture through the diaphragm is more or less spirally continued on on its inner side.

Inwardly the film of sarcode lining the inner portion of the hourglass opening of the crust is in continuation with that lining the areolar or vacuolar cavities situated at the circumference of the parenchyma of the sponge, into one of which this part of the hourglass opening expands itself; and here, at the commencement of the expansion, may be observed minute apertures, which are more or less scattered all over the surface of the areolar cavity. Some of these appear to be intended to keep up communication between the adjoining areolar cavities, while others, viz. those on the vault or portion next the crust, are the terminations of certain canals coming from the surface of the sponge, to be hereafter mentioned.

Externally the hourglass opening is covered by the dermal sarcode when this is present, which is not always; for it is frequently absent in parts, having probably been rubbed off by the rolling about of the free specimens in the sand at the bottom of the sea; but whether present or absent, the hour-

glass cavity and its diaphragm remain the same in all other respects.

This dermal sarcode presents a great number of minute papillæ scattered more or less over its whole surface, each of which is terminated by an equally minute aperture, the latter frequently more in appearance than reality, since a thin film of sarcode is frequently stretched across it, which, in its turn, may or may not be provided with a central opening, the presence or absence of these openings being probably fortuitous—that is, depending on certain conditions of the sarcode during the death or desiccation of the sponge. (Pl. II. fig. 10.)

The papillary apertures, averaging a little more or less than 1-1000th of an inch in diameter, are chiefly congregated, over the openings of the hourglass-shaped cavities of the crust, into distinct areæ, each of which is more or less convex and presents an appearance like the top of a pepper-box (that is to say, a convexity pierced by the papillary apertures), which area itself is often pursed outwards in the centre also in a papillary form, with an aperture, in the living state, probably, at its termination.

Lastly, the papillary apertures which are immediately over the outer part of the hourglass-shaped opening in the crust lead directly into this cavity, and those at the circumference of the area to minute canals which pass down to the vault of the areolar cavity (into which the inner portion of the hourglass-shaped opening expands itself), through the hourglass opening, but *outside* its sarcodal lining; while the papillary apertures of the crust generally (that is, those altogether outside the areæ) lead to similar canals which traverse the crust opposite to them, and also open within into the vault of the nearest areolar cavity. The two latter sets are the openings of the canals to which I have alluded when describing the inner portion of the hourglass-shaped opening in the crust.

I have not been able to observe any apertures opening into either portion of the hourglass cavity through its sarcodal lining direct; and the minute spicules so abundant in the dermal sarcode are seldom present in it or in its diaphragmatic expansion. These spicules in the dermal sarcode are frequently arranged sponge-like around the papillary apertures—that is to say, after the manner of poles supporting a conical tent.

Thus it will be seen that there are many points of difference between Dr. Bowerbank's and my descriptions, which need not be particularized, as both the latter are given above, *in extenso*; and should ocular demonstration be desired to confirm the statements I have made, this may be obtained by vertical

and horizontal sections of the crust in fresh, half, and wholly dried specimens respectively of *Pachymatisma Johnstonia*, carefully made and manipulated under the microscope, taking the precaution never to reflect the film of sarcode which lines the cavities under examination, as this at once destroys all certainty respecting the apertures which may or may not exist in them in their intact state.

One point, however, I would notice, viz. that I have not had an opportunity of seeing the aperture in the diaphragm open and close as stated by Dr. Bowerbank, which statement must have been an inference, as it refers to a specimen of *Geodia Barretti*, which had been "pickled in strong salt and water" (Phil. Trans. p. 1099).

I have stated that, at this early period of animal development, we should not expect to find tissues of the same kind as those in higher animals, and therefore that Dr. Bowerbank's application of the term "membrane" to the dermal sarcode is not legitimate. But although the whole of the soft substance of the sponge on drying becomes agglutinated into a homogeneous mass like glue, there are frequently many parts of it in the fresh state, and sometimes in the dried (*ex. gr.* the cortex of *Tethya lyncurium* &c.), where tissue-like structure faintly appears.

To deny, therefore, the presence of tissues in the sarcode of the lowest grades of animal life is not theoretically correct, however much it may be desirable to do so for practical purposes.

We cannot see the elements of which water or glass is composed, but inference leads us to the conclusion that the one is formed of particles of matter in an uncrystallized, and the other in a crystallized condition. Indeed, if we could see either in either state, there would be an end of all microscopy.

All we know of things is by comparison, and for practical purposes we discourse of those characters which are most familiar to our senses; still we cannot help seeing in the sarcode of the sponge a looming of tissues which, like objects approaching from a distance, become more evident to us in the coarser, more durable, and more evident developments of the higher animals.

But, to return to Dr. Bowerbank's "true pores," which I have, in my description of the "Ultimate Structure of *Spongilla*" (Annals, 1857, vol. xx. p. 21), designated "apertures" of the investing membrane. These I discovered in 1856, while at Bombay (Annals, Sept. 1856, vol. xviii. p. 242). The manuscript was in the hands of the printer in England in the month of June, and the first part published in the 'Annals' on the

1st of August. Dr. Bowerbank announced his description of those apertures at the meeting of the British Association held on the 30th of August; and on the 1st of September appeared the other part of my paper, to which my note on the subject was appended. Thus, had the whole of my paper been published at once, I should have preceded Dr. Bowerbank in his announcement by just one month. Yet Dr. Bowerbank *very* frequently alludes to his own announcement both in the 'Philosophical Transactions' and in the 'British Sponges,' of 1862 and 1866 respectively, without ever mentioning my name in connexion with it; while my figure and particular account of those apertures, in the 'Annals' of 1857, is still, I believe, the only published illustration of the fact.

If it be assumed that this reticence arose from not reading my papers, then it must be also assumed that Dr. Bowerbank did not read what was published on his own special subject, and, consequently, that what is stated in the 'British Sponges' &c. is mostly upon his own *ipse dixit*: lacking, therefore, authority, it lacks confidence.

It matters little who has discovered these apertures, so long as the fact is made known to the public; but the *suum cuique* should be a sacred obligation among individuals; and nothing that is put before the public loses by additional evidence.

Globular crystalloids.

This term I use for the little siliceous bodies which, closely packed together, form a hard crust on *Geodia* and *Pachymatisma*, whether free or in contact with attached pieces of rock or coral, and also sometimes coat the calibre of the larger excretory canals of the latter for some distance into the parenchyma of the sponge; so that they are evidently accumulated in those parts which are most likely to come into contact with foreign objects. They are imbedded in living sarcode of the sponge, which, acting as a plastic bond of union between them, thus gains access to the surface, where it forms the dermoid layer, charged, as before stated, with minute spicules peculiar to the species.

They are found generally in a more matured form in the crust, especially in *Pachymatisma*, than in the body of the sponge, and, after full development, might be transferred from the latter to the former probably as easily and as naturally as an *Amœba* discharges its undigested material through the surface of its body, viz. without injury. But being chiefly confined to the crust in *Geodia arabica*, while they abound generally in the body of *Pachymatisma Johnstonii*, it becomes

questionable whether the whole of those formed in the crust are not entirely developed there.

Be this as it may, they begin their development, and for some time follow it, very much like the radiated crystallization of minerals, viz. first commencing from a central point, surrounded by radiating hair-like spicules, which finally become consolidated into a globular mass. Here, however, they leave the spheroidal or mineral for the organic form, and become oval, compressed, provided with an umbilical depression in the centre, and a surface of clavate tubercles with more or less flat or conical heads according to their position.

It is remarkable also that, in the vertical section caused by fracture, the body is found to have become a clear crystalline solid globule, still faintly showing the radiated lines of its early structure extending from the centre to the circumference (Pl. I. fig. 12 *a*, & Pl. II. fig. 14 *b*). On no occasion have I been able to detect a central cavity in any stage of their development, either in their natural state or after having been exposed to a red heat, when the axial canals of the long spicules almost invariably become expanded, and indicate, from their charred appearance, the presence of more or less animal matter. At whatever period, even under these circumstances, the crystalloid was broken, whether in its early unconsolidated hair-like or in its subsequent crystalline compact state, the same structure was continuous from the centre to the circumference; there was no appearance of central cavity. Thus, however much they resemble the seed-like bodies of *Spongilla* in appearance, they totally differ from them in their structure and in their nature. The seed-like body of *Spongilla* is incomparably larger, commences as a simple spherical soft cell, looking like a white speck imbedded in the sponge, and finally becomes coated with its horny or siliceous spicular cortical coat, as the case may be. (Annals, 1849, ser. 2. vol. iv. pl. 3. fig 6; and 1859, ser. 3. vol. iii. pl. 8. fig. 3.)

To these globular crystalloids Dr. Bowerbank has applied the term "ovaria," stating that, "In an early stage they appear as a globular body of fusiform acerate spicula, radiating from a central point in the mass" (Phil. Trans. 1862; Brit. Spong. vol. i. p. 141), that in the midst of this central point "a central cavity is produced in which the incipient ova very shortly appear," that the inner and acute terminations of the radiating spicules form "the common inner surface of the cavity of the ovarium, which is now filled with an opaque mass of ova," that "a single conical orifice or foramen has also been produced in a portion of the wall, through which the ova are destined to be ejected," and that this takes place by

the growing again inwards of the spicules, so as to fill up the cavity to their original "central point" of departure.

It is needless to criticise this deliberately detailed statement, which is by no means borne out by the figures intended to illustrate it, whatever the bodies may have been from which these were taken (Brit. Spong. pl. 22. fig. 327, and Phil. Trans.). It must have been as difficult, one would think, to obtain all this information with the microscope as for a closed *siliceous* cavity to form itself in the central point of a radiating mass of spicules, then secrete ova in its interior, then form a hole for their exit, and then close its cavity up again so as to become a compact ball of silex, termed by the author an "adult" or "mature ovarium" (!) (Phil. Trans. *l.c.* p. 815; Brit. Spong. vol. i. p. 143).

Alluding to these globular crystalloids in *Pachymatisma*, Dr. Johnston, with his natural modesty and love of truthfulness, observes:—"The bodies which Dr. Bowerbank has described as the *gemmules* of its crust are, he writes me, very much alike in structure to the granules of the *Geodia*, which he finds also occur in the body of this sponge as well as in the crust. This suggests the query whether the cuticular granules of *Geodia* may not be truly gemmules; but I confess that to me it appears the question should be answered in the negative. Their position, their siliceous and crystalline character, and the mode of their aggregation, seem all opposed to it, and not less so the difference between them and the recognized gemmules of some Halichondriæ." (Hist. Brit. Sponges, p. 202.)

It seems to me that if the globular crystalloids of the crust of *Geodia* are to be considered ovaria, the large stellate bodies of *Tethya lyncurium*, which are similarly situated and very nearly as large (bearing the proportion of 6 to 8), should also have this distinction; but these are called by Dr. Bowerbank "stellate spicula." (Brit. Spong. vol. ii. p. 92.)

Again, in a compound tunicated animal, about the size and shape of half a small pea, which, although probably described before, I have but just noticed on the branches of the fucoid *Cystoseira granulata*, in juxtaposition with *Grantia ciliata*, the mass, which is of the whiteness of snow, is chiefly composed of globular crystalloids of carbonate of lime, presenting conical points all over them, very similar to fig. 13 *a*, Pl. I. This crystalloid, when compared with that of *Geodia arabica*, bears the proportion in diameter of 3 to 8, but, although much smaller and composed of carbonate of lime instead of silex, has exactly the radiated mineralogical structure of the globular crystalloids of *Pachymatisma* and *Geodia arabica* (fig. 12, *a*, Pl. I., and fig. 14, *c*, *b*, Pl. II.).

Now, surely, it cannot be said that these globular crystalloids, firmly packed in between the cells of an Ascidian and bound down by its general tough integument, can be the "ovaria" of this animal.

In short, I can see nothing to account for the opinion that the globular crystalloids of the crust of *Geodia* and *Pachymatisma* (for they are both alike) are "ovaria," excepting the undiscovered presence of any other propagative form in the species, in which case, if the crystalloids were ovaria, they would demonstrate the fact directly. These animals do not propagate by a gemmule here and there, but by tens of thousands; and among all the crystalloids of these two sponges that I have examined in all stages of development, by fire, water, fracture, and acid, I have not been able to find one with anything approaching to a central cavity.

With reference to the Ascidian mentioned, I might also here cursorily state that it is almost as full of starch-granules, dispersed among the crystalloids, as would be an equal amount of potato-substance. The conical projections of the crystalloids, too, have very much the appearance of "dog's tooth" calcspar, as if structurally developed under a combination of animal and mineral influence.

Reproductive Elements.

In an illustrated paper on the identity of the seed-like body of *Spongilla* and the winter-egg of the freshwater Bryozoa (Annals, ser. 3. vol. iii. p. 331, 1859), I have endeavoured to show that the seed-like bodies of *Spongilla* are so nearly allied in their structure and nature to the winter-eggs of the so-called freshwater polypes that, for the present at least, we must regard them as gemmules. This resemblance was pointed out long ago by Meyen (*ap.* Johnston, *op. cit.* p. 154, footnote). They are chiefly formed in the oldest part of the structure (that is, at the base of *Spongilla*), and are eliminated on the disintegration of the mass, which is more or less effected by the winds and the dry weather to which it is exposed after the water has left it adhering to the sides of the tanks and quarry-pits in the island of Bombay, where it so abundantly grows. Subsequently, when the tanks become refilled by "the rains," towards the end of July, the eliminated seed-like bodies may be seen in great numbers, together with the winter-eggs of the freshwater Bryozoa, floating about on the surface of the water, where, after having become thoroughly soaked, they begin to throw out their sponge-like substance, and, adhering to floating objects on, or to rocks beneath, the water, finally grow there into new sponges; while the seed-like bodies still re-

maining at the base of the parent chiefly renovate the old mass—although such is the nature of the sarcode of *Spongilla*, that I think almost any portion of it, on becoming thoroughly soaked, even after drying for a whole hot season, might, under advantageous circumstances, grow into a new individual.

With such properties, then, the seed-like body seems to be more allied to a bud than anything else, and therefore truly to deserve the name of "gemmule."

The "ciliated gemmule," first described by Dr. Grant, and latterly more at length by M. N. Lieberkühn (Annals, 1856, vol. xvii. p. 407) as the "swarm-spore," I have not yet had an opportunity of seeing either in the fresh- or salt-water sponges. But of its existence there can be no doubt; and if it had been particularly sought after, probably it would not have escaped my observation.

I have, however, as will have been seen, described and figured bodies in *Tethya arabica* (fig. 19, Pl. II.) which seem, under the circumstances, to be very much allied to the gemmules of *T. cranium* figured by Dr. Johnston. They are of all sizes below 15-6000ths of an inch in diameter, and situated in the fleshy part of the *Tethya*, chiefly towards its base, where they, by the aid of a common lens, appear in the form of little white specks scattered plentifully throughout this substance. The white speck, however, is not the whole of this body; for when it is viewed through the microscope by transmitted light, it is seen not only to be spherical in itself, but also to be surrounded by a spherical transparent capsule, charged with minute bacillary bodies resembling spicules, but not siliceous, I think, although resisting the solvent power of nitric acid applied to them on the slide. They may be albuminous tubes on which future spicules might be developed, but are too minute for anything but conjecture of this kind. On the other hand, the spherical nucleus or opaque white body itself appears to be composed of albumino-oleaginous matter, in some instances assuming the form of minute globular masses, but for the most part so consolidated by first the drying and then, latterly, the soaking in spirit and water of the sponge for elementary examination, that hardly more can be satisfactorily stated of it than that its contents *appear* to be albumino-oleaginous, and that these had a minute globular structure.

Still there are these bodies scattered in great abundance through the fleshy portion of the sponge; and they seem to get their capsule developed in proportion to their size, so that at an early period they would be nothing but white albuminous spherules.

I have not been able to find anything like them in *Tethya*

lyncurium or in *Pachymatisma Johnstonia*; and of course they could not, if present, be detected in the dried state of *Geodia arabica*; nor has any one ever described such bodies in either of these species; but gemmules have been described and figured in *Tethya cranium* by both Johnston and Bowerbank, and therefore it is interesting to find something of the kind in the Arabian representative of this sponge.

Two kinds of gemmules, with marked difference, have been described and figured by Dr. Bowerbank in *T. cranium* (Brit. Spong. pl. 25. figs. 343, 344); but when he adds (vol. ii. p. 87) that "It is highly probable that this marked difference in structure is sexual, and, from the more highly developed condition of the second or largest form, that it is the female [!] or prolific gemmule," it can only be hoped that Dr. Bowerbank's illustrations are, as usual, much better than his physiological interpretations.

We use the terms "sperm" and "germ-cell" for the male and female elements of the true or impregnative process of generation; but the term "gemmule" stands for "bud," in which no one has yet detected more than a portion of the product evolved from a combination of the male and female elements of generation.

In short, the true or impregnative process of generation in the Sponge has not yet been made public, even if ever discovered. Lieberkühn (*l. c.*) has stated that he has seen cells filled with spermatozoa in *Spongilla*; Prof. Huxley has described and illustrated what he considers to be spermatozoa in an Australian species of *Tethya*; and I have latterly endeavoured to throw more light on the subject by pointing out the probability that in the freshwater Rhizopoda (e. g. *Difflugia*) the nucleus furnishes the *sperm-*, and some other part of the body of *Difflugia* the *germ-*cells, which produce the new generation (Annals, 1865, vol. xv. p. 172). But how far this may be correct in itself, or how far it may apply to the generative process in the sponges, remains still to be discovered, since at present this process is as much a mystery as the generative process was in the stipitate Fungi before Œrsted and Karsten demonstrated that it took place through the union of male and female cells growing out of the mycelium.

I observe, however, that much of the sponge-substance on the surface of *T. arabica* is charged with minute nucleated cells about 2-6000ths of an inch in diameter, frequently grouped together, as if the group had been developed in one cell—and that the substance so charged is especially supported on the rays of the trifid spicule, as shown in fig. 20, Pl. II. Neither could I help being struck with their resemblance to similar nucleated

cells which I have found and described in the chambers of *Operculina arabica*, and which in some specimens of this test in my possession may be seen (for they appear to be the same) on their way out from the introseptal canals, or at the orifices of holes in the spire, covered with a coating of white calcareous matter. What the real nature of those supported on the trifid spicules of *Tethya arabica* may be I must leave future observation to determine.

Spicules.

In describing the spicules, it is very desirable to state whether they are straight or curved, as they maintain this characteristic feature throughout in the species which I have described, whatever their other forms may be. In vain we look for this in the specimens of "specific description" proposed by Dr. Bowerbank (Phil. Trans. 1862, p. 1132) for "adoption by naturalists," and, of course, followed in his individual descriptions.

Now in *Tethya arabica* and *Tethya lyncurium*, as may be observed by the illustrations &c., they are all straight, whereas in *Geodia arabica* and *Pachymatisma Johnstonia* they are all curved, however varied in other respects.

When we look for a figure of the spiculum of the latter in Dr. Bowerbank's illustration of *Pachymatisma* (Phil. Trans. 1862, pl. 72. fig. 6, and Brit. Spong. fig. 353), we find the spicules there not only almost all straight, but for the most part also pointed at each end, instead of being all curved in the shaft and round or inflated at the ends; so that one is tempted to doubt if it be a figure of this sponge.

Again, when we turn to the two figures of *Geodia Barretti* in the Phil. Trans. (pl. 72. fig. 5, and pl. 32. fig. 2), the latter of which is repeated in the Brit. Spong. fig. 354, we find fig. 2 three times as large as fig. 5, and the "radii of the patentoternate" spicules in fig. 301 (Brit. Spong.) still larger; yet they are all set down as "×50 linear." Which is the true representation? Generally speaking, these illustrations are beautifully executed; but of their truthfulness are we to say, after having only examined one or two of them, *ex uno disce omnes*?

Had Dr. Bowerbank drawn these figures himself, these mistakes could hardly have occurred; neither ought they to have come before the public so untruthful under any circumstances.

But the plan throughout pursued by Dr. Bowerbank, in his description of the Spongiadæ, can never suffice for the subject. Mere magnified views of the elementary parts alone of objects

described in new terms, for the most part borrowed from the Greek, instead of from the language of the country, which would supply nearly all that is necessary, must ever prove more or less enigmatical, and therefore correspondingly tiresome and impracticable.

We shall never get a satisfactory idea of the Spongiadæ until the species have been simply but truthfully figured side by side with their elementary parts, and as simply described. Association, with both, will then supply what the latter certainly fails to do separately.

It was with this view that I sent home to Dr. Bowerbank nearly all the collection I made on the south-east coast of Arabia, thinking that he was about to accomplish this great work, which requires a master mind of no ordinary ability to produce, and the confidence of a bold publisher to print. But my collection, with many others, are locked up in Dr. Bowerbank's El Dorado, which, like his papers published successively by the Royal and Ray Societies, contain many good things, if one could only get at them.

Classification.

A glance at my figures will show that *Tethya lyncurium* differs so much from *T. arabica* that it cannot rightly be placed in the same genus with the latter; while *T. arabica* is so nearly allied to *T. cranium* that these two also must of necessity come together. Hence Dr. J. E. Gray, in his arrangement (Proc. Zool. Soc. Lond. May 9, 1867), has very properly made a separate genus, under the name "*Donatia*," for *T. lyncurium*. His third or "club-shaped" spicule is but a modification of the subulate or awl-shaped form common to the species.

Again, for sponges of the type of *Tethya cranium* he has assigned the term "Tethya;" and here my *T. arabica* must of course come. Thus *Donatia* and *Tethya* form the first genera respectively of his first and second divisions of the Tethyadæ. Dr. Bowerbank places both under the genus *Tethya*.

Under Dr. Gray's *Tethya* should also come my *T. dactyloidea*, described and figured in the 'Annals' for January last (p. 15), which, I regret to state, lacks minute detail, from my having parted with the specimen.

The genus *Pachymatisma* naturally appears first in Dr. Gray's family of Geodiadæ; and my *G. arabica*, being closely allied to *G. zetlandica*, under his third genus, viz. that termed "Cydonium."

With Dr. Gray's love for the subject, together with his great

ability, long experience, and the advantages afforded by the British Museum for reference both to specimens and publications, we could not have a better authority in point of classification; but, of course, this must depend very much upon the assertions of others, which, if incorrect, reflect dishonour upon those with whom they originated, and not upon the author of the classification.

In offering the few remarks above mentioned, I do not pretend to comment on the subject generally; and should it hereafter be found that my *Tethya arabica* and *Geodia arabica* are one and the same respectively with the *T. cranium* and *G. zetlandica* of our own shores, which, on more careful examination of the latter, I do not think unlikely to be the case, it will be so far fortunate that the species have been thus reduced, and my names obliterated, feeling as I do conscious of the but too melancholy conclusion expressed by Raspail, at the end of the preface to his 'Dict. de Termes des Sciences Naturelles,' that "La science ne marche que par la nouveauté des faits; et la nouveauté des mots, ou la rend stationnaire ou bien la fait rétrograder."

EXPLANATION OF PLATES I. & II.

N.B. All the figures in these plates are more or less diagrammatic, for convenience of illustration, except the drawings of the four Sponges themselves, which are delineated after nature.

The measurements (of course, approximate) are given in units indicating so many 1800ths of an inch, or in fractions of these, unless otherwise stated, by which the relative proportions in size of the objects can be seen directly, and the real ones readily ascertained by computation, if desired.

Plate I.

Fig. 1. *Tethya arabica*, n. sp., natural size, showing the hispid state of the surface and three large vents.

Fig. 2. The same, section to show internal structure: *a*, matted sponge-substance of surface supported on the distal portions of four kinds of spicules terminating respectively in single-pointed, bifid and trifid extended, and trifid recurved extremities; *b*, sponge-substance of body supported on bundles of spicules overlapping each other, which radiate from the centre to the circumference, and present between them the truncated canals of the efferent or excretory system; *c*, nucleus, consisting of densely matted sponge-fibre interwoven with intercrossing spicules.

Fig. 3. The same, portion of surface magnified, showing reticular arrangement of the lines of spicules with pores in the interstices. Seen only in the fresh or undried state.

Fig. 4. The same, forms of the distal extremities of the spicules of the surface, respectively, all smooth and straight: *a*, stout, fusiform, pointed at both ends, 250 long by $2\frac{1}{4}$ broad (that is,

250-1800ths long by 2½-1800ths of an inch broad); occasionally pointed only at the distal and rounded at the other end, awl-shaped: *b, d*, slender, bifid and trifid respectively; shaft pointed, 460 long by 1 broad; rays 6 long by ½ broad, all pointed: *c*, slender, trifid recurved, shaft pointed, 320 long by ¾ broad; rays 6 long by ½ broad, all pointed.

Fig. 5. The same, characteristic spicule of the body; straight, smooth, fusiform, pointed at each end, 250 long by 2½ broad: *a*, occasional spicule, fusiform awl-shaped, round at one extremity, pointed at the other, or rounded more or less at both ends. These two spicules also enter into the composition of the crust.

Fig. 6. The same; very minute spicules and siliceous globules, most numerous in the matted structure of the crust; the former like bits of thread, sigmoid and semicircular respectively, more or less contorted; largest sigmoid form 1-2000th inch long by 1-24000th inch broad; siliceous globule 1-6000th inch in diameter.

Fig. 7. The same; occasional spicules somewhat larger than the last, found in the sarcode generally: *a*, shaft semielliptical, incurved and pointed hook-like at the extremities, more or less contorted; largest 10-6000ths inch long: *b*, direct, half-lateral, and lateral views respectively of a similar but more complicated hooked form; shaft consisting of three curves, of which the central is the largest; extremities trifid, rays expanded and webbed together like a waterfowl's foot, incurved in the opposite direction to the external curvatures of the shaft, which are the reverse of the central one; 6-6000ths inch long.

The latter is an intricate form, but easily understood by drawing the curves &c. in accordance with the description.

Fig. 8. The same, real lengths of the spicules respectively: *a*, bifid and trifid extended; *b*, trifid recurved; *c*, body-spicule. (See figs. 4 and 5 respectively.

Fig. 19 (Pl. II.). The same, form of gemmule (?), showing nuclear, opaque, or white portion, enclosed in a transparent capsule charged with extremely minute, bacillary, pointed, spiculiform bodies; 4-1800ths inch in diameter; bacillary body 1-6000th inch long.

Fig. 20 (Pl. II.). The same, trifid spicule of surface, bearing sponge-substance charged with nucleolated cells; largest cells about 1-3000th inch in diameter.

Fig. 9. *Geodia* (*Cydonium*, Gray) *arabica*, n. sp. (Pl. I.), natural size; dried specimen, found on the sea-shore, probably after having been much exposed to friction in the waves, as no dermal sarcode remained upon it; showing surface *uncovered* by dermal sarcode, dimpled over with little pores, and here and there larger ones, probably the vents (oscules) or terminations of the efferent canals. All much smaller than during the living state, the reduction in size having been produced by contraction in drying.

Fig. 10. The same, section to show internal structure (taken from another specimen): *a*, crust composed of globular crystalloids, covered with dermal sarcode charged with minute spicules; *b*, zone of trifid spicules of different forms supporting the crust; *c*, sponge-substance of the body supported on stout curved fusiform spicules arranged more or less in a direction radiating from the centre, presenting the truncated canals of the efferent or excretory system; *d*, central portion more compact than the rest.

Fig. 11. The same, portion of surface more magnified: *a*, part of crust, showing pores uncovered by dermal sarcode; *b*, portion covered with dermal sarcode charged with minute, smooth, curved fusiform spicules, pointed at each end; *c*, form of dermal spicule more magnified, size 18 to 25 long by ½ broad. (To compare in size with body-spicule (fig. 15), which is ten times as long.)

For more details of the dermal sarcode and pores, see illustrations of *Pachymatisma Johnstonia*, Pl. II.

Fig. 12. The same, globular crystalloid of the crust, oval obtuse, compressed in the axis of the umbilicated central depression: *a*, vertical section, showing:—the crystalline nature of the body, traversed by faint lines radiating from the centre; the umbilicated depression below; also the margin, formed of the clavate tubercles of the surface. Size, 8 long by 7 broad and 5 thick.

For the development and further illustration of this body, see that of *Pachymatisma*, Pl. II.

Fig. 13. The same, *minute* stellate crystalloid with which the structure generally is more or less charged, particularly towards the circumference, 1 to 6-6000ths inch in diameter: *a*, not unfrequent form, 8 to 11-6000ths inch in diameter.

Fig 14. The same, forms of distal ends of the spicules of the zone (fig. 10 *b*) which supports the crust, respectively; all smooth and pointed; proportionally magnified: *a*, robust, triradiate; shaft straight, 205 long by 7 broad; rays more or less slightly undulated, 15 long by 6 broad: *b*, end view of head, to show triradiate form, shaft truncated: *c*, trifid extended, less robust; shaft straight, 420 long by 3 broad; ray 5 long by 1 broad: *d*, trifid recurved, shaft much the same as the last, straight, 370 long by 2 broad; ray 5 long by 1 broad (these spicules are arranged in groups; and there are about five to eight of the more slender forms, *c* and *d*, to one of the robust, *a*): *e e*, occasional forms.

Fig. 15. The same, characteristic spicule of the body; stout, curved, smooth, fusiform, pointed at each end; size 205 long by 4 broad.

Fig. 16. The same, real lengths of the spicules respectively: *a*, trifid extended; *b*, trifid recurved; *c*, triradiate; *d*, body-spicules. (See figs. 14 and 15 respectively.)

Plate II.

Fig. 1. *Tethya* (*Donatia*, Gray) *lyncurium*, Lam., natural size: *a*, view of exterior, showing lobate or warted surface; *b*, vertical section, showing the cortical portion pierced by the expanded bundles of spicules, which, radiating from the centre or nucleus, terminate by broken extremities on the surface.

Fig. 2. The same, portion of the surface more magnified, showing by the dotted points the broken ends of the spicules as they traverse the wart-like lobes, and the depressions in the interangular spaces where the pores and vents are respectively situated.

Fig. 3. The same, vertical section, more magnified, showing:—*a*, cortical portion formed of sponge-fibre horizontally interwoven with the expanded ends of the bundles of spicules radiating from the centre—the whole so dense as to assume the appearance and consistence of cartilage; *b*, sponge-substance of the body supported on the radiating bundles of spicules, which overlap each other and present between them the truncated canals of the

efferent or excretory system; *e*, nucleus, consisting of densely interwoven sponge-fibre and spicules, resembling the cortical portion in appearance and composition.

***Fig.* 4.** The same, characteristic spicule of the sponge generally; straight, smooth, more or less fusiform, awl-shaped; seldom if ever pointed at both ends, although frequently much attenuated; shorter and more abruptly terminated on one side than on the other, the enlarged end round, sometimes inflated. Size, 70 to 120 long by ½ to 2 broad: *a*, largest, real length.

The distal ends of those spicules which, projecting beyond the cortical portion, appear to be always broken off, probably do not differ from the one just described, as no other form of long spicule than this is to be found in any other part of the sponge.

***Fig.* 5.** The same, large stellate crystalloid, more or less scattered throughout the structure, but most numerous at the point of contact between the cortical and body portions; rays more or less in number, often undulated, and sometimes bifid at the extremities. Total diameter 1 to 6; central globule or body of largest 2 in diameter; ray 2 long; body and rays all smooth, clear, and crystalline.

***Fig.* 6.** The same, *minute* stellate crystalloid, relatively magnified, to compare with the foregoing; 2 to 4-6000ths inch in diameter: *a*, more magnified view; *b*, ray still more magnified, to show its rough spinous surface.

***Fig.* 7.** *Pachymatisma Johnstonia*, Bowerbank (Pl. II.), natural size of specimen: *a*, view of the exterior, showing pores and large vents: *b*, section through the centre, showing thickness of crust and cut portions of the efferent or excretory system of canals. Structure amorphous, massive; centre undistinguishable.

***Fig.* 8.** The same, section of interior, more magnified, to show the character of the efferent system of canals.

***Fig.* 9.** The same, portion of surface more magnified: *a*, part of crust uncovered by dermal sarcode, showing the pores only; pores 1-24th inch in diameter and about 1-12th inch apart, but slightly variable both in size and proximity: *b*, portion covered with dermal sarcode, charged with the minute, rough, fusiform spicules peculiar to the species; pores beneath faintly, if at all, seen in the fresh state.

***Fig.* 10.** The same, portion of the surface covered by the dermal sarcode, greatly magnified, showing the papillary apertures of the afferent or incurrent canals dispersed over it generally, but more particularly over the area covering the pore, which is situated in the centre, averaging about 1-32nd part of an inch in diameter; papillary aperture about 1-900th inch in diameter, but slightly variable in size.

***Fig.* 11.** The same, pore greatly magnified, surrounded by the globular crystalloids of the crust, showing:—*a*, the diaphragmatic extension of the sarcodal lining, and *b*, its central opening; the former very variable, 10 to 25 in diameter, and the latter more constant, averaging 6 in diameter.

***Fig.* 12.** The same, vertical section of pore, showing hourglass-shaped cavity covered in externally with dermal sarcode and opening below into one of the areolar cavities at the circumference of the sponge: *a*, external chamber of hourglass cavity; *b*, internal chamber, opening into areolar cavity; *c*, dermal sarcode surmounted by papillary apertures; *d*, diaphragm of pore; *e*, spiral opening in the same, more or less extended, but in this instance

carried inwards for four or five coils in a tubular form, constricted in the middle.

Fig. 13. The same, magnified view of dermal spicule, 2 to 5-6000ths long by 1-6000th inch broad: *a*, more magnified view, to show rough, subspinous or tuberculous character.

Fig. 14. The same: *a*, globular crystalloid of the crust, elliptical, compressed in the direction of the axis of the umbilicated depression in the centre: *b*, vertical fracture, showing the clear crystalline nature of the body, traversed by faint lines radiating from the centre, the umbilicated depression below, also the margin formed of the clavate tubercles of the surface; size 8 long by 4 broad and 6 thick: *c*, early form, showing hairlike appearance of spicules radiating from the centre; size 2-6000ths inch in diameter: *d*, more advanced stage, portion of surface to show the conical form assumed by the ends of the now half-coherent, hairlike, radiating spicules: *e*, fully developed state, portion of surface to show its star-like facetted form.

Fig. 15. The same, *minute* stellate spicule, more or less scattered throughout the whole structure; rays variable in number, subspinous; total diameter of largest forms 12-6000ths inch; central globule 1 to 2-6000ths inch in diameter; ray 6 to 12-6000ths inch long: *a*, more magnified view of the ray, to show its spinous character.

Fig. 16. The same, triradiate spicule supporting the crust, shaft and rays all pointed: *a*, terminal view of same, with shaft truncated; *b*, another form, with rays and shaft all rounded or inflated at extremities. This spicule in *Pachymatisma* is subject to great variation in every respect.

Fig. 17. The same, characteristic spicules of the body: *a*, more slender form; *b*, real length. These are all curved, smooth, more or less cylindrical or fusiform, with round or inflated extremities, seldom if ever pointed; longest about 85 by 2. They are also subject to great variation based upon the form given.

Fig. 18. The same, extreme varieties of spicules: *a*, early stage of globular crystalloid, with spicule projecting from umbilicated depression; *b*, elliptical form of long spicule; *c*, club-shaped form; *d*, hourglass form.

For the description of figs. 19 and 20, see Explanation to Pl. I.

[I could have wished that the lines of the spicules in figs. 15 and 17 of Plates I. and II. respectively had been more even. But *I* am content; for the hand which did them is now paralysed in death, although others, without this explanation, might be dissatisfied, from want of association. They were the last efforts of the long and useful career of one who has heretofore etched my drawings, as well as, probably, those of many others, with an ability and accuracy which, as in the present instance, with the exceptions mentioned, left nothing to be reasonably desired.]

II.—*Note on an Alciopid, a Parasite of* Cydippe densa, *Forskål.* By EDWARD RENÉ CLAPARÈDE, Professor of Comparative Anatomy in the Academy of Geneva, *and* PAUL PANCERI, Professor of Comparative Anatomy in the Royal University of Naples*.

[Plate V.]

THE authors, having made in the month of March last observations on the same subject, which agree and are mutually complementary, have determined to publish them in conjunction, and prior to other works, in order to make known sooner the first and perhaps the only observations that have been made on the metamorphosis of the *Alciopæ*†, and to illustrate this case of endoparasitism, singular among the Annelida‡.

Among the many deep-sea animals which the currents bring into the Gulf of Naples, and which delight as well the resident naturalists as those who resort to these shores from distant countries, one of the numerous and elegant forms of the Beroids is a Pleurobranch, corresponding, as we think, to the *Cydippe densa* of Forskål, better described by Gegenbaur under the more recent name of *C. hormiphora*§. In some individuals of this species, obtained at different periods, there were visible within the gelatinous mass, and also towards the outer surface of the body, some white corpuscles, which at first sight we took for those larvæ of *Distoma*, with the tail armed, which have been described by G. Müller || as *Cercaria setifera*, and subsequently by Graeffe as *C. thaumantiatis*¶,

* Translated and kindly communicated by A. H. Haliday, A.M., from the 'Memorie della Società Italiana di Scienze naturali,' tomo iii. No. 4. Milan, 1867.

† An Alciope larva seems to have been seen by Leuckart (Arch. f. Naturg. xxi. 1855); but, to judge from the figure, we are inclined to think it may have been a young animal in the act of reproducing the posterior extremity of the body.

‡ As ectoparasitic or sedentary Annelida may be considered (besides a great number of *Hirudinea*) the *Stylaria* and the *Chætogaster* of *Lymnæus* and other Naids, as also the Amphinomid discovered by Fritz Müller in the cavity of the shell of *Lepas anatifera*, and referred to by him in his essay 'Für Darwin,' 1864, pp. 29, 30; to which we have now to add the *Myzostomum* of *Comatula*, according to what Mecznikow has published concerning its development and its position among the Annelida (Zeitschr. f. wissensch. Zoologie, Bd. xvi. 1866).

§ Studien üb. Organisat. u. Systematik der Ctenophoren (Arch. f. Naturg. Bd. xxii. 1856). [= *Cydippe plumosa*, Sars, = *Hormiphora plumosa*, Agassiz.—*Note by* TR.]

|| Ueber eine eigenth. Wurmlarve (Arch. f. Anatomie u. Physiologie, 1850, p. 497).

¶ Beobacht. üb. Radiat. u. Würmer in Nizza (Denkschr. der Schweiz. Naturf. Gesellschaft, Bd. xvii. 1858).

For further details about these larvæ, see Claparède, Beobacht. üb.

and which commonly, and sometimes in multitudes, inhabit the external surface of nearly all the Acalephæ of the ocean and the Mediterranean; but the coexistence of others of a larger size, and the presence of minute Annelida in the stomach, have led us, with the help of direct observations, to the conviction that all these parasites are larvæ of Annelida, which the development and pigment of the eyes early indicated to belong to the family of the Alciopids.

The smallest of these larvæ, which we will call the **first stage**, and which scarcely attain the length of 1 millim., have the head not yet distinct from the rest of the body, and without any vestige of appendages. The eyes are not protuberant, but represented by a small crystalline lens, nearly spherical, posterior to which and in the interior is seen a layer of pigment. The body, elongated and with scattered pigmentary spots, has no indication of the division into segments, except in the presence of three pairs of conical feet, having each two short projecting setæ: vibratory cilia were observed in two tracts—from the mouth to the middle of the abdominal surface, and again in the extreme posterior region. The opening of the mouth has the form of a simple fissure, to which succeeds a muscular tube, then a spacious gastric sac, open behind.

In the larvæ which we call the second stage, the head acquires a greater development; the eyes become prominent, and, in addition to the crystalline and the layer of pigment, show a ring which defines their outline. The oral segment has now become apparent, furnished with two rudimentary appendages; and the tube now becomes gradually exsertile from the mouth. The body is more elongated, has lost the cilia, and, besides the three rings furnished with setigerous feet, shows the outlines of the consecutive segments.

The larvæ in the third stage attain the length of 2–3 millims.; and the largest of them have four tubercles, which are the first vestiges of the antennæ. The eye is further increased in volume, and the choroid is gradually acquiring pigment in its posterior segment. The other feet, additional to the three primitive pairs, become furnished with setæ, and are gradually developed, so that sixteen segments or more may now be counted, the anterior ones possessing prominences and pigmentary spots, representing respectively the cirrus and the tubercles of the dorsal region in its more advanced stage.

Anatomie u. Entwicklung wirbelloser Thiere an der Kuste von Normandie, 1863, p. 12, and the investigations on the same subject by Prof. A. Costa (Rendiconto d. R. Accad. d. Sc. Fisiche e Matematiche di Napoli. fasc. 4, Aprile 1864).

The cirri of the feet and the spots become more conspicuous in the next or fourth stage, in which the antennæ are better marked, the eyes enlarged, the number of segments increased to nineteen, and the body attains the length of 4 millims.

But it is in the fifth stage that the structure of the eyes is best seen, as they now appear surrounded by several layers of cells, the nuclei of which are easily rendered visible by means of an ammoniacal solution of carmine, and which are probably of nervous matter, composing as they do that layer external to the choroid which exists, as is known, in the adult *Alciope* as well as in many Mollusca, the Cephalopoda and Heteropoda for instance, in which the gangliary portion of the retina is seen posterior to the choroid. It is in this stage (distinguished further by the appearance of the capillary setæ) that we were enabled to distinguish the dorsal vessel with the perfectly transparent blood.

In the sixth stage, the four antennæ are still more produced, and the choroid appears completely lined with pigment, and composed of grains disposed in perfectly regular series. Besides the nervous layer composed of cells of which we have spoken, another layer is visible, exterior to this, surrounding the entire bulb, which, though composed of cells resembling those of the nervous matter, is analogically to be considered a sclerotic. The crystalline is evidently enlarged, and beyond the nucleus presents the appearance of stratification. The larvæ in this stage measure 5 millims. in length, and have from twenty to thirty segments. The feet of the first three pairs, which evidently correspond to the original feet of the larva in its first stage, appear smaller than the rest, and consist of a stump, deprived of the setæ and sheathing fine acicular darts, and of two cirri, the dorsal one conical, the ventral short and broader in proportion. The other feet have become more developed; they are conical, with a dorsal cirrus in the form of a pedunculated oval plate, and a smaller ventral cirrus, besides a dorsal tubercle with scattered pigment-cells, the ramifications of which are interlaced in an intricate manner. The setæ are of two sorts,—the first numerous, capillary, simple, flexible; the others larger, one of them projecting a little from the foot, with a surface armed with very delicate spinules, while the other, of similar structure, remains concealed in the interior of the foot, like a dart with the point only a little exserted*.

* Setæ and a surface beset with very minute spines have been described by one of the authors in a larva of a Dorsibranch, as yet undetermined, which has some points of analogy to the one in question (Claparède, Beobacht. t. vi. p. 77).

The larvæ of the most advanced stage which we have observed are a centimetre long, with about thirty-six segments. The upper antennæ are elongated and somewhat porrected, while the lower ones retain the form of tubercles. The eyes, now more amply developed, have the form which they exhibit in the adult *Alciope*, and, in conjunction with the lobes of the head, have the faculty of executing movements which change the direction of their axis. Except the hindmost pairs, which still want them, the feet are furnished with setæ, as has been stated already, and as is shown in the figures.

In all these larvæ, besides the pigmentary spots of the dorsal tubercles, there are also pigment-cells, more or less dark in colour, with fine ramifications, in the tegument of the head and of the dorsal portion of the segments; but these have not, except in the first stage of the larvæ, the regular arrangement usual in the larvæ of other Annelida.

The larvæ from 5 to 10 millims. long we have found in the stomach of the *Cydippe*; and we should have been inclined to consider them to have been accidentally introduced, or as the food of the *Cydippe*, if we had not obtained the others, of smaller size, from the external tissues of the animal. This seems to establish that they are parasites, inhabiting probably the gastrovascular canals. Hence it seems to us a reasonable supposition that the eggs, detached from the dorsal tubercles of the mother, to which they appear constantly to adhere for a certain period in the *Alciope*, as is proved to be the case with other Annelida, are then swallowed by the *Cydippe*, and pass, along with the serochyme, by means of the four principal canals which branch off from the bottom of the stomach, into the pleural canals, and from them into the smaller ones, whence, as the growth of the larva goes on, they find their way back into the larger canals and the stomach, out of which they may easily escape or be expelled. Yet another hypothesis may be considered—that the eggs are developed at large in the water, and that the swimming larva penetrates into the *Cydippe*—on which supposition the cilia may be regarded as the instruments of locomotion. But, in either case equally, whether the eggs are hatched in the body of the *Cydippe* or out of this, as the cilia of the hexapod larvæ are few and soon disappear entirely, both these circumstances attest the parasitic habits of the larvæ. The prolonged existence of these organs in swimming larvæ, and their persistence in some parts of a great number of adult Annelida, and even of some adult animals of the same family to which our larvæ belong, corroborate the importance of this character, which is intimately related to the particular mode of life which we have describ

No doubt it will have seemed strange to the readers of the title of this Note that deep-sea Annelida, with eyes so well developed and with natatory organs, should pass through a stage as parasites, which might have been more readily admitted in the case of Annelida shapeless, blind, and degraded; and yet it seems to us very evident that the larvæ we have described, and perhaps those of other Alciopids also, present this condition of temporary endoparasitism for this very end, that the eyes and feet, under such circumstances, may have time and the conditions favourable to their development and growth.

In conclusion, it may be demanded to what form of the Alciopids these larvæ are to be referred. In the most advanced stage to which we have traced them, they cannot be assigned to any known genus: but whether the tentacles of the oral segment continue short or are lengthened in the progress of development, we shall have a new genus, characterized principally by the four antennæ, the two tentacles of the oral segment, and by the difference of structure of the first three pairs of feet from the rest, as well as by other characters of generic value, which may be gathered from the description we have given. The subjects being larvæ, and not adult animals, we cannot at present give a complete and positive character; nevertheless, being convinced that the genus is new, we propose to distinguish our Annelid by the name of *Alciopina parasitica.*

Subsequently to these studies of ours, Herr Buchholtz, of the University of Greifswald, having observed, at Naples also, in the month of May, similar larvæ in the same *Cydippe*, on collating these with ours, has found that they are of the same genus, but differ as to the number of the large setæ, which are four instead of two, and not muricated, accompanied by a dart. These observations, while they confirm our suspicion that there are other kinds of Alciopids which resemble that described by us in the mode of life at first, present a new incitement to further investigations of the subject.

EXPLANATION OF PLATE V.

Fig. 1. *Cydippe densa*, Forskål, with parasitic larvæ inside. The stomach and principal gastrovascular canals injected.

2, 3, 4. Ciliated larvæ, first stage. Natural length 1 millim.

5. Larvæ, second stage; the cilia gone.

6, 7. Larvæ, third stage, in which the antennæ begin to appear and the feet acquire greater development. Nat. length 2–3 millims.

Fig. 8. Larva, fourth stage, with the development of the antennæ, eyes, and feet more advanced. Nat. length 4 millims.

Fig. 9. Larva, fifth stage; the dorsal vessel and the flexible setæ have made their appearance.
Fig. 10. Larva, sixth stage: the three original pairs of larval feet have lost the setæ; the others are furnished with two sorts of setæ. Nat. length 5 millims.
Fig. 11. Larva, seventh stage, in which the upper pair of antennæ are more developed. Nat. length 10 millims. The tube is represented in the act of emerging.
Fig. 12. Eye of larva in sixth stage: *a*, swelling of the cephalic ganglion; *b*, gangliary layer of the retina; *c*, choroid; *d*, crystalline; *e*, sclerotic.
Fig. 13. Fragment of the choroid.
Fig. 14. Foot of larva in the sixth and seventh stages: *a*, dorsal cirrus; *b*, abdominal cirrus; *c*, foot proper; *d*, dorsal tubercle.
Fig. 15. Setæ: *a*, the larger spinulous ones; *b*, the simple flexible ones.

III.—*On a new Volute.* By Frederick M'Coy, Professor of Natural Science in the University of Melbourne.

[Plate III. figs. 1 & 2.]

Voluta (*Amoria*) *canaliculata* (M'Coy).

Sp. Ch. Elongate-ovate; spire short, of $4\frac{1}{2}$ whorls, distinctly channelled at the suture; pillar with four strong, subequal, oblique plaits, the most posterior continued into ridge of anterior thickened belt. Colour whitish (faded specimen), with, on body-whorl, five spiral rows of longitudinally elongate-oblong tawny spots, one row at the suture. Total length 1 inch $8\frac{1}{2}$ lines, proportional length of aperture $\frac{80}{100}$, greatest width $\frac{40}{100}$.

This Volute differs from the *V.* (*Amoria*) *maculata*, which it most nearly resembles in shape and colouring, by the spots being more numerous and shorter, by the plaits of the pillar being oblique, by the width being greater and the greatest width being nearer the suture, and by the suture being distinctly canaliculated.

I obtained the only specimen I have seen of this species, for the National Museum at Melbourne, from Mr. R. Thatcher, who had observed the fact of its being specifically distinct from the *V.* (*A.*) *maculata*.

Locality. Port Denison.

EXPLANATION OF PLATE III.

Figs. 1 & 2. *Voluta canaliculata*, back and front views, natural size.

IV.—*Considerations on the Neuropterous Genus* Chauliodes *and its Allies; with Notes and Descriptions.* By R. M'Lachlan, F.L.S.

It is by no means an axiom in natural history that the larger the object the easier it is to comprehend its affinities; and the insects on which I am now about to make some observations exemplify this in a striking degree. The genera *Chauliodes* and *Corydalis* contain some of the largest Neuropterous species; yet no two genera, perhaps, show less well-marked lines of demarcation or more instability of structure in organs that are generally looked upon as giving tolerably good means for generic diagnosis. It may be of service, therefore, if I propound my views on this subject, deduced from a consideration of the much-increased materials that have now accumulated. For *Corydalis* the enormously elongated mandibles of the male of most species, as exemplified in *C. cornuta*, and for *Chauliodes* the strongly pectinated antennæ and equal mandibles, as shown in the typical *C. pectinicornis*, at one time seemed enough for all generic purposes; but an increased knowledge of forms has shown these grounds to be thoroughly insufficient. Thus in *Corydalis* we find such species as *C. Hecate* (which cannot be generically separated from *C. cornuta* without organizing a system of splitting that would retard rather than advance the science) with equally short mandibles in both sexes; and in *Chauliodes* the structure of the male antennæ is subject to infinite specific variation, these organs being pectinate, foliate, serrate, or simple, according to the species. Looking, therefore, for more stable characters, I regard the presence of few or many transverse veinlets in the wings as the most important character, combined with the presence or absence of a sharp tooth at the lower angles of the head, though, as will be shown, this latter is subject to much modification.

In 1832, G. R. Gray, in Griffith's edition of Cuvier, proposed the term *Hermes* for an insect with simple male antennæ, but which can scarcely be considered other than a *Chauliodes*. In 1842, Rambur, in his 'Histoire des Névroptères' (Suites à Buffon), separated four species under a genus which he called *Neuromus*; two of these are closely allied to *Corydalis*, the others can be regarded as only forms of *Chauliodes*, one of them being identical with Gray's type of *Hermes*. However, I propose to adopt Rambur's genus for his two most typical species and for allies since discovered. Their relationship to *Corydalis* is very close, yet they have a facies that separates them therefrom, and the tooth at the hinder angles of the head

vanishes in some species, showing a good transition between *Corydalis* and *Chauliodes*, the wings having the numerous transverse nervules of the former. Authors have variously adopted these several terms. Walker, in his British-Museum Catalogue, uses *Corydalis*, *Chauliodes*, and *Hermes*, placing in the latter Rambur's most typical forms of *Neuromus* and many species of *Chauliodes*; and the two species described in his paper in the Trans. Ent. Soc. London, new series, vol. v. should both be referred to *Neuromus*. Hagen, in his North-American Synopsis, adopts only *Corydalis* and *Chauliodes*, placing in the former the typical species of *Neuromus*; and in this he was for the most part followed by me in my revision of Walker's species in the 'Journal of the Linnean Society, Zoology,' vol. ix. Brauer, in the first part of his elaborate Catalogue of Neuroptera, has *Corydalis*, *Chauliodes*, and *Neuromus*; and though the list of the species he proposes to place under each is not yet published, I opine that he views the genera in the same light as I now do. The three genera may be briefly diagnosed thus:—

CORYDALIS.

Alæ venulis transversalibus plurimis. Antennæ maris simplices vel denticulatæ. Mandibulæ maris elongatæ vel breves. Capitis angulis posticis dente acuto instructis. Forma valde robusta. Color plus minusve fuscescens.

NEUROMUS.

Alæ venulis transversalibus plurimis. Antennæ maris simplices. Mandibulæ ♂ ♀ breves, æquales. Capitis angulis posticis dente evidenter vel obsolete instructis. Forma minus robusta. Color plus minusve pallidus.

CHAULIODES.

Alæ venulis transversalibus paucis. Antennæ maris pectinatæ, foliaceæ, serratæ, vel simplices (interdum in fœmina serratæ). Mandibulæ ♂ ♀ breves, æquales. Capitis angulis posticis inermibus.

In *Neuromus*, *N. grandis* and *N. infectus* approach more nearly to *Chauliodes*, as they want the tooth on the hinder angles of the head; yet they possess the numerous transverse nervules and the general appearance of *N. testacea*. The species of this genus much resemble each other, even to the frequent presence of a black line, or spots, on each side of the thorax.

I conclude this paper by noticing some synonymic corrections, by describing some new species, and by giving a list of the species I propose to place under *Chauliodes* and *Neuromus*.

Hermes costalis, Walker (of which *Hermes anticus*, Walker, is a ♀) is identical with *Neuromus grandis*, Thunberg (*Hemerobius grandis*, Thbg. Nov. Ins. Sp. pt. i. p. 28, fig. 44, from Japan). The species varies considerably in the number of pale spots; and the Chinese examples show an approach to my *C. infectus* from Darjeeling.

Hermes dubitatus, Walker (without locality), is not the ♀ of *Chauliodes californicus*, as supposed by Hagen, in which he was followed by me (Journ. Linn. Soc., Zool. vol. ix.), but is identical with *H. diversus*, Walker (New Zealand). The types of *diversus* have the wings much crumpled, and I have only recently seen perfect examples.

Hermes maculifera, Walker, appears to be only the ♀ of *maculipennis*, Gray, though the difference of the localities (Malabar and Java) would favour the suspicion of their being distinct.

Chauliodes disjunctus, Walker (in Lord's 'Naturalist in Vancouver's Island and British Columbia'), is a good species of *Chauliodes*, and the largest yet known. I also possess it from Vancouver's Island, but have only seen females.

Hermes 10-*maculatus* and *H. corripiens*, Walker (Trans. Ent. Soc. Lond. new series, vol. v.), are species of *Neuromus* allied to *N. testaceus* and *N. hieroglyphicus*. *Corripiens* is from Brazil; but there is no label to indicate the locality of 10-*maculatus*.

Chauliodes fraternus, n. sp.

C. nigro-fuscus. Caput nigrum, postice utrinque sub oculis, et in macula triangulata, nitido-rufescens. Antennæ nigræ. Prothorax subquadratus, paullo latior quam longus. Alæ sat latæ, griseo-subhyalinæ, saturate griseo nebulosæ; pterostigma macula magna elongata nigro-fusca utrinque ornatum; area subcostalis maculis nigro-fuscis; venulis costalibus crassis, curvatis, nigro-fuscis: posticæ fere ut anticæ. Long. corp. 13‴; exp. alar. 50‴ (♀).

Hab. in China septentrionali. In coll. Mus. Brit.

Blackish fuscous. Head black above, with a triangular, reddish, shining spot in the middle of the posterior margin, and the sides below the eyes also reddish; beneath shining piceous. Antennæ black, obsoletely serrate internally. Mandibles piceous. Prothorax subquadrate, slightly broader than long, scarcely narrower than the head without the eyes, fuscous, suffused with yellowish in the middle above. Meso- and metathorax fuscous. Abdomen dull blackish fuscous. Legs greyish yellow; knees, femora internally, tibiæ externally, and tarsi wholly fuscous; trochanters and femora clothed with short yellowish pubescence.

Wings rather broad, greyish, subhyaline, clouded with darker grey, especially in the apical half, with a large, elongate, blackish-fuscous spot on each side of the pale pterostigmatical region, and with blackish-fuscous spots in the subcostal area; costal veinlets curved, strong, blackish fuscous; longitudinal veins blackish fuscous; transverse veinlets of the disk few, fine, and pale: the coloration of the posterior wings almost precisely identical with that of the anterior.

Allied to *C. japonicus* and *C. Bowringi*, more closely to the former, but apparently distinct.

Chauliodes tenuis, n. sp.

C. griseo-testaceus. Antennæ maris simplices. Prothorax elongatus, capite angustior. Abdomen nigricans, appendicibus superioribus elongato-conicalibus, inferioribus fere obsoletis. Pedes ochracei, genibus tarsisque fuscescentibus. Alæ anticæ angustæ, griseo-subhyalinæ, conferte griseo notatæ, punctis tribus griseo suffusis inter sectorem et cubitum posticum nigricantibus: posticæ hyalinæ, punctis duobus inter sectorem et cubitum nigricantibus (♂). Long. corp. 11'''; exp. alar. 26'''.

Hab. in Africa australi. In coll. Mus. Brit.

Greyish testaceous. Head elongate. Antennæ concolorous, simple. Prothorax elongate, narrower than the head; metathorax ochreous. Abdomen blackish; superior appendices elongately conical, hairy. Legs ochreous; knees and tarsi fuscescent.

Anterior wings elongate, narrow, subacute, subhyaline, with a greyish tinge, and with numerous small pale-grey spots arranged somewhat in transverse series; in the space between the sector and cubitus anticus are three blackish, somewhat corneous points, each clouded with grey; neuration pale fuscous: posterior wings hyaline, with greyish neuration; there are two blackish points in the same area as in the fore wings.

A somewhat delicate insect, from Kysna, South Africa; allied to the New-Zealand *C. diversus*, but smaller.

List of described Species of Chauliodes.

Asia.

C. sinensis, Walker.

Chauliodes sinensis, Walk. Cat. Brit. Mus. Neurop. p. 199 (1853).
China.

C. japonicus, M'Lachlan.

C. japonicus, M'Lachl. Journ. Linn. Soc., Zool. vol. ix. p. 232 (1867).
Japan.

C. fraternus, M'Lachlan, *ante*, p. 37.
North China.

C. simplex, Walker.

C. simplex, Walk. Cat. Brit. Mus. Neurop. p. 200 (1853).

Silhet.

C. Bowringi, M'Lachlan.

Hermes sinensis, Walk. Cat. Brit. Mus. Neurop. p. 203 (1853). *C. Bowringii*, M'Lachl. Journ. Linn. Soc., Zool. vol. ix. p. 260.

Hongkong.

C. subfasciatus, Westwood.

C. subfasciatus, Westw. Cab. Or. Entomol. p. 70, pl. 34. fig. 5 (1848); Walk. Cat. Brit. Mus. Neurop. p. 200.

Silhet.

C. pusillus, M'Lachlan.

C. pusillus, M'Lachl. Journ. Linn. Soc., Zool. vol. ix. p. 231 (1867).

India? (locality unknown).

*C. maculipennis**, G. R. Gray.

Hermes maculipennis, Gray, in Griffith's edit. of Cuvier, vol. ii. p. 331, pl. 72. fig. 1 (1832). *Neuromus ruficollis*, Ramb. Névrop. p. 443 (1842). *Hermes ruficollis*, Walk. Cat. Brit. Mus. Neurop. p. 202. *Hermes maculifera*, Walk. Cat. Brit. Mus. Neurop. p. 203 (1853).

Java, Malabar.

Australia and New Zealand.

C. guttiferus, Walker.

Hermes guttiferus, Walk. Cat. Brit. Mus. Neurop. p. 204 (1853).

Australia.

C. diversus, Walker.

Hermes diversus, Walk. Cat. Brit. Mus. Neurop. p. 205 (1853). *H. dubitatus*, Walk. *op. cit.* p. 204.

New Zealand.

Africa.

C. tenuis, M'Lachlan, *ante*, p. 38.
South Africa.

* This is the most aberrant species of the genus, and its relationship to *Neuromus grandis* and *infectus* is close, even to the character of the markings: hence, if it should hereafter be considered desirable to reinstate Gray's genus *Hermes*, these three species should be placed therein.

North America.

C. pectinicornis, Linné.

Hemerobius pectinicornis, Linn. Amœn. Acad. vi. p. 412 (1763); Syst. Nat. ed. xii. p. 911. *Semblis pectinicornis*, Fab. Sp. Ins. vol. i. p. 386. *Chauliodes pectinicornis*, Latr. Gen. Crust. et Insect. vol. iii. p. 198; Burm. Handb. p. 950; Ramb. Névrop. p. 444; Walk. Cat. Brit. Mus. Neurop. p. 198; Hag. Neurop. N. Amer. p. 189.

Canada and United States.

C. rastricornis, Rambur.

C. rastricornis, Ramb. Névrop. p. 444 (1842); Walk. Brit. Mus. Cat. p. 198; Hag. Neurop. N. Amer. p. 189. *Hermes indecisus*, Walk. Cat. Brit. Mus. Neurop. p. 204 (1853) ♀.

United States.

C. virginiensis, Drury.

Hemerobius virginiensis, Drury, Ex. Ins. (1773). *Chauliodes virginiensis*, Westwood, ed. Drury, vol. i. p. 105, pl. 46. fig. 3; Hag. Neurop. N. Amer. p. 190. *Hemerobius pectinicornis*, Palis. Beauv. Ins. Afr. et Amér. pl. 1. fig. 2, nec Linn. (teste Hagen).

Virginia.

C. californicus, Walker.

C. californicus, Walk. Cat. Brit. Mus. Neurop. p. 199 (1853); Hag. Neurop. N. Amer. p. 190.

California.

C. angusticollis, Hagen.

C. angusticollis, Hag. Neurop. N. Amer. p 191 (1861).

United States.

C. disjunctus, Walker.

C. disjunctus, Walk. in Lord's 'Naturalist in Vancouver's Island and British Columbia,' vol. ii. app. 384 (1866).

Vancouver's Island.

C. serricornis, Say.

C. serricornis, Say, in Long's Exped. vol. ii. app. p. 307 (1823); Hag. Proc. Ent. Soc. Phil. vol. ii. p. 180; Burm. Handb. p. 949. *Neuromus maculatus*, Ramb. Névrop. p. 442, pl. 10. fig. 2 (1842). *Hermes maculatus*, Walk. Cat. Brit. Mus. Neurop. p. 202. *C. maculatus*, Hag. Neurop. N. Amer. p. 191.

Canada, United States.

C. fasciatus, Walker.

C. fasciatus, Walk. Brit. Mus. Cat. Neurop. p. 201 (1853); locality ("New Holland") erroneous. *C. serricornis*, Hag. Neurop. N. Amer. p. 190, nec Say. *C. lunatus*, Hag. Proc. Ent. Soc. Phil. vol. ii. p. 180 (1863).

United States.

South America.

C. cinerascens, Blanchard.

C. cinerascens, Blanch. in Gay's 'Historia fisica de Chile,' vol. vi., Atlas Novróp. lám. ii. fig. 10 (1851).

C. chilensis, Hag. Neurop. N. Amer. app. p. 321 (?), not described.

Chili.

Neuromus infectus, n. sp.

N. brunneus; thorax vitta interrupta nigra utrinque ornatus. Caput lateribus inermibus. Antennæ nigræ, simplices. Alæ anticæ pallide fuliginosæ, maculis magnis plus minusve confluentibus in dimidio basali, unaque rotundata discali pone medium, albidis; venulis costalibus albido marginatis: posticæ pallidiores, dimidio basali hyalino, macula rotundata pone medium ut in anticis. Long. corp. 12–15‴; exp. alar. 38–49‴ (♂ ♀).

Hab. Darjeeling. In coll. Mus. Brit., Oxon., et auct.

Brown or brownish testaceous; pro- and mesothorax above with an interrupted black line on each side. Antennæ simple in both sexes, black. Prothorax longer than broad, narrower than the head. Legs blackish fuscous (paler in the ♀), with the base of the tibiæ, and the femora beneath, ochreous. Appendices of the ♂—app. sup. elongate, acuminate, turned inwards, dull greyish, hairy; app. inf. long, two-jointed, the basal joint short, the second joint very long, curved strongly inwards, acute, the points crossing; ventral plate very deeply excised, the sides produced into long, triangular, straight processes.

Wings: anterior wings pale smoky fuscous, shining (paler in the ♀), with large, irregular, more or less confluent, whitish blotches in the basal half, and a large, rounded, isolated whitish spot in the disk beyond the middle; costal veinlets white and margined with whitish, so that the interstice between each veinlet seems to be occupied by an oblong fuscous space; costa, subcosta, radius, and all the apical neuration, fuscous; the basal veins and veinlets in the whitish blotches are yellowish; transverse discal veinlets numerous in the apical half: posterior wings paler than the anterior; the basal half hyaline with yellowish neuration, the apical half smoky, with fuscous neuration, no basal blotches, but with the isolated round discal spot beyond the middle, as in the anterior.

Allied to *N. grandis*, Thbg., of which it might be considered a strongly marked local form, and the Chinese examples of which approach it in coloration; but that species appears to have short and truncate superior appendices, though with a like-formed ventral plate.

Neuromus montanus, n. sp.

N. pallide fusco-griseus. Caput parvum, elongatum; lateribus dente acuto instructis, ochraceis. Antennæ graciles, nigræ; articulo secundo pallido. Mandibulæ palpique griseo-ochracea. Prothorax longior quam latus, capite vix angustior, fusco-griseus. Pedes ochracei. Alæ pallide albido-stramineæ; venulæ costales, discales, venaque cubitalis ad basin fuscæ, tenues, reliquæ flavidæ (♀). Long. corp. 11‴; exp. alar. 37‴.

Hab. Sikkim Himalaya, alt. 9000′. In coll. Mus. Brit.

Head small, elongate, posterior angles with a sharp tooth; ochreous, the sockets of the ocelli blackish. Antennæ very slender, black, the second joint pale. Mandibles and palpi greyish ochreous. Prothorax longer than broad, scarcely narrower than the head, greyish fuscous, the deflexed sides margined with lurid fuscous. Meso- and metathorax grey. Abdomen blackish (but the colours probably altered). Legs entirely ochreous, finely pubescent; the claws castaneous.

Wings very pale whitish straw-colour; the costal and discal transverse nervules and the base of one of the cubital nervures fuscous, not incrassated; the neuration otherwise yellowish.

One badly preserved individual in the British Museum, from Lacken, Sikkim Himalaya, at an elevation of 9000 feet.

Neuromus fenestralis, n. sp.

N. rufo-brunneus. Caput latum; lateribus anguste alatis, dente robusto instructis; circum ocellos basinque antennarum nigrum. Antennæ nigræ; articulo primo rufo, supra in medio nigro notato; secundo ad basin nigro, ad apicem rufo. Mandibulæ nigræ. Maxillæ rufæ, ad basin nigræ. Prothorax capite angustior, late nigro limbatus. Abdomen, meso- et metasternum flavo-ochracea; abdominis segmento ultimo supra in medio producto; appendicibus superioribus elongatis, crassis, paullo clavatis, intus sinuatis; inferioribus valde elongatis, triarticulatis, articulis duobus terminalibus brevibus, ultimo forcipato, acuto. Pedes nigri; antici femoribus intus, coxis trochanteribusque omnino rufo-ochraceis; intermedii posticique femoribus, coxis trochanteribusque omnino rufo-ochraceis. Alæ anticæ fuliginoso-fuscæ, albo fenestratæ et maculatæ, nigro nervosæ; venulis costalibus crassis, nigro marginatis: posticæ fusco-subhyalinæ (♂). Long. corp. 16–19‴; exp. alar. 45–51‴.

Hab. Darjeeling. In coll. Mus. Brit.

Reddish brown. Head broad, narrowly produced at the sides, and furnished with a strong acute tooth at the lower angles; disk above with fine, raised, intricately wavy lines, an elongate and somewhat smooth space in the middle posteriorly; front (portion in front of the ocelli) rugose-punctate; sockets of the ocelli and of the antennæ black. Antennæ

black, the basal joint red, with a black mark above; second joint black at the base, red at the apex. Mandibles and base of the maxillæ black. Palpi reddish. Prothorax much narrower than the head, rather longer than broad, above finely transversely rugose, the sides broadly black. Mesonotum ochreous, suffused with fuscous. Abdomen and the underside of meso- and metathorax yellowish ochreous. The last abdominal segment is produced in the middle above. Superior appendices elongate, thick, clubbed at the apex, the inner edge sinuate; inferior appendices long, three-jointed, the two terminal joints short, the last curved abruptly inwards, claw-shaped and acute; penis (or that which I take for it) long, flattened, transversely wrinkled, acuminate and truncate at the apex. Legs—anterior pair black, with a line on the inner side of the femora, and the trochanters and coxæ wholly, reddish; intermediate and posterior pairs with black tibiæ and tarsi, otherwise reddish.

Anterior wings smoky fuscous, with the costal and subcostal areas paler; two very large subquadrate white spaces (traversed by black veins), one near the base, the other in about the middle, extending from the radius more than half across the wing; beyond these are two or three small quadrate white spots on the disk, and two or three between the radius and sector; costal veinlets very strong, straight, black, and margined with black; longitudinal veins and transverse veinlets (especially those of the base) strong and black: posterior wings subhyaline, tinged with fuscous; costal veinlets, and those between the radius and sector, black, the latter clouded with blackish.

I have seen two males of this conspicuous species.

Neuromus latratus, n. sp.

N. sordide brunneus. Caput latum; lateribus anguste crenulato-alatis, nigris, dente acuto instructis; brunneum. Antennæ mandibulæque nigræ. Prothorax capite angustior, longior quam latus, maculis elongatis duabus utrinque nigris. Meso-, metathorax et abdomen griseo-ochracea; abdominis segmento ultimo supra in medio producto; appendicibus superioribus crassis, clavatis; inferioribus biarticulatis, articulo secundo abrupte incurvato, acuto; penis (?) elongatus, ad apicem excisus. Pedes ochracei, tibiis tarsisque nigris. Alæ griseo-subhyalinæ, posticæ pallidiores: anticæ venulis costalibus, basalibus et illis inter radium et sectorem incrassatis, nigris; venis longitudinalibus flavis (♂). Long. corp. 17‴; exp. alar. 48‴.

Hab. in India orientali. In coll. Mus. Brit.

Dull brown. Head broad, brown; the sides narrowly mar-

gined, the produced portion being crenulate and black; sockets of the ocelli black; disk with fine wavy, intricate, raised lines. Mandibles and antennæ black. Prothorax much narrower than the head, longer than broad, finely transversely rugose, a lanceolate smooth space in the middle posteriorly; on each side is a black vitta divided into two elongate spots, whereof the lower is the longer and is furcate at its upper end. Meso- and metathorax and abdomen dull ochreous; last abdominal segment produced in its middle above into a somewhat quadrate process; superior appendices moderately long, the tips thickened, clothed with fine yellowish pubescence; inferior appendices long, two-jointed, the second joint abruptly curved inwards in the form of an acute claw; penis (?) long, flat, the sides parallel, the apex acuminate, sulcated beneath, and bifid, the two extreme tips turned slightly outwards. Legs dull ochreous, with all the tibiæ and tarsi black.

Wings greyish, subhyaline, the posterior pair paler; in the anterior wings all the costal veinlets strong and black; the basal veinlets and those between the radius and sector also strong and black, and margined with black; apical veinlets fuscous; longitudinal veins yellow: posterior wings with the costal veinlets, and those between the radius and sector, black.

I have seen one male. The part which I have called the penis, in this and the last species, is perhaps not truly that organ, and may be only a greatly elongated lower valve.

Neuromus intimus, n. sp.

N. griseo-luteus. Caput modice latum, dente utrinque instructum, inter ocellos nigrum. Antennæ (præter articulos duos basales) mandibulæque (macula ad basin excepta) nigræ. Prothorax supra utrinque nigro bimaculatus. Appendices superiores elongatæ, latæ, ad apicem acuminatæ: inferiores biarticulatæ, geniculatæ; articulus primus brevis, tuberculo ad basin instructus, secundus elongatus, acutus. Pedes flavi; tibiis tarsisque nigro-fuscis, intus pallidioribus. Alæ griseo-hyalinæ: anticæ venis longitudinalibus flavis, venulis costalibus discalibusque incrassatis, nigris: posticæ venulis costalibus illisque inter radium et sectorem nigris (♂). Long. corp. 14–15‴; exp. alar. 41–43‴.
Hab. in India orientali. In coll. Mus. Brit.

Pale greyish yellow. Head moderately broad, the sides scarcely produced, but with an evident tooth at each lower angle; a black spot between the ocelli. Antennæ black, the two basal joints yellow. Mandibles black, with a pale spot at the base externally. Prothorax slightly narrower than the head, and slightly longer than broad; two large oval black spots on each side above, the lower being the larger. Abdo-

men brownish: superior appendices long, broad, flattened, the apex acuminate and turned under, pubescent: inferior appendices long, two-jointed, the basal joint very short, broad, and with a rounded tubercle at the base, above; second joint very abruptly turned inwards at an acute angle with the first joint, long, claw-shaped, the tips being black, curved, and acute: ventral plate (last ventral segment) nearly quadrate, but with the apical margin broadly and shallowly excised. Legs—femora yellow; tibiæ and tarsi blackish, brownish internally, with yellow pubescence.

Wings hyaline, with a very slight greyish or fuscous tinge: in the anterior wings the costal veinlets and almost all the transverse veinlets are thickened and black; longitudinal veins yellow, the costa, subcosta, and radius being somewhat brownish: posterior wings with the costal veinlets and those between the radius and sector black, neuration otherwise yellow.

I have seen two males of this species, which is most nearly allied to *N. testaceus*, Rambur, but differs in the colour of the legs and in the appendices.

List of described Species of Neuromus.

N. grandis, Thunberg.

Hemerobius grandis, Thbg. Nov. Ins. Sp. pt. 1. p. 28, fig. 44 (1781). *Hermes costalis*, Walker, Cat. Brit. Mus. Neurop. p. 207 (1853). *H. anticus*, Walk. *op. cit.* p. 205 ♀ (1853).

Japan, China.

N. infectus, M'Lachlan, *ante*, p. 41.

Darjeeling.

N. hieroglyphicus, Rambur.

Neuromus hieroglyphicus, Ramb. Névrop. p. 442 (1842). *Hermes hieroglyphicus*, Walk. Cat. Brit. Mus. Neurop. p. 206. *Corydalis hieroglyphica*, Hag. Neurop. N. Amer. p. 194.

Central America, Brazil.

N. corripiens, Walker.

Hermes corripiens, Walk. Trans. Ent. Soc. Lond. new ser. vol. v. p. 180 (1860).

Brazil.

N. 10-maculatus, Walker.

Hermes 10-maculatus, Walk. Trans. Ent. Soc. Lond. new ser. vol. v. p. 180 (1860).

Brazil (?) or India (?).

N. testaceus, Rambur.

Neuromus testaceus, Ramb. Névrop. p. 442, pl. 10. fig. 1 (1842). *Hermes testaceus*, Walk. Cat. Brit. Mus. Neurop. p. 206.

Java, India (?).

N. intimus, M'Lachlan, *ante*, p. 44.

India.

N. albipennis, Walker.

Hermes albipennis, Walk. Cat. Brit. Mus. Neurop. p. 206 (1853).

Nepaul.

N. montanus, M'Lachlan, *ante*, p. 42.

Himalaya.

N. latratus, M'Lachlan, *ante*, p. 43.

India.

N. fenestralis, M'Lachlan, *ante*, p. 42.

Darjeeling.

N.B. It is possible that some of the South-American species placed under *Corydalis* in the Appendix to Hagen's 'Synopsis of North American Neuroptera,' and mentioned by name only, may belong to *Neuromus*.

I do not feel in a position to give a catalogue of the species of *Corydalis* (which genus is peculiarly American), especially as so many undescribed species are noticed by Hagen.

V.—*Note on the Animal of* Limnæa involuta (*Harvey*). By A. G. More, F.L.S.

[Plate III. fig. 3.]

The shell of *Limnæa involuta* is now to be seen in many collections; but very little appears to be known concerning the external form of the animal itself, which, in the most recent works on British conchology, still remains undescribed, though the species is by general consent placed under *Amphipeplea*, whether as a section or subgenus.

Having last week visited the small lake called Lough Crincaum, on Cromaglaun Mountain, 798 feet above the sea, I collected there a number of specimens, which have been living for several days in a glass bowl under constant observation. I am thus enabled to say, with regard to the disputed question of the investing mantle, that there is no ap-

pearance of any outer lobe or expansion of the animal covering the outside of the shell, as in *Amphipeplea glutinosa.* The mantle in *Limnæa involuta* is not developed to any greater extent than in other allied species, such as *L. peregra* and *L. auricularia*; and the external surface of the shell remains at all times uncovered, whether the animal is expanded or not.

Description.—Body olive-brown shading in the centre into slaty grey, and mottled with darker colour inside the shell. Tentacles broadly triangular. Eyes nearly sessile. Foot broad, oblong, rounded and slightly emarginate in front, narrowed behind into a shortish tail.

Mr. W. H. Baily, of the Geological Survey of Ireland, has kindly made a drawing from the living animal, which has never previously been figured; and from our figure (magnified 2 diams.) it will be seen that the animal closely resembles that of *Limnæa* as drawn in plate iv. of the first volume of Gwyn Jeffreys's 'British Conchology,' except that the body of *Limnæa involuta* is rather narrower, and the tentacles broader at the base.

Glasnevin, May 25, 1869.

VI.—*On the Cestoid Worms of the Bustard.* By Dr. H. Krabbe*.

[Plate III. figs. 4–13.]

A tapeworm which, from its peculiar appearance, long since attracted attention, and has been easy of recognition, is the *Tænia villosa* occurring in *Otis tarda.* It was described and figured by Bloch†, who gave it the above name on account of the fringed appearance of one of its margins, which is due to the fact that the posterior angle of one side of each joint is drawn out into a narrow process. In five bustards which he examined there were at least 500 in each, and in a young bird which had been reared in captivity he estimated the number of worms at about 1000. Bloch states the length to be 4 feet; and the number of joints should be, according to his calculation, at least 32,000, which, however, is probably about ten times the actual number.

At the same time it was treated of under the name of *Tænia*

* Translated from the 'Videnskabelige Meddelelser fra Naturhistorisk Forening i Kjöbenhavn, for Aaret 1867,' pp. 122–126, by W. S. Dallas, F.L.S.

† Abhandl. von der Erzeugung der Eingeweidewürmer (Berlin, 1782), p. 12, tab. 2. figs. 5–9.

Otidis by Werner*, who had obtained his specimens from Leske. He noticed the difficulty with which it is extricated, from the masses into which it readily twists itself together, and of which he gave a figure.

Rudolphi† also found it in great numbers in *Otis tarda* at Greifswald, and referred it to the *Tæniæ* with an unarmed proboscis. Bremser‡ and Nitzsch § gave figures of it. Dujardin|| doubted whether it was destitute of hooks on the proboscis.

Of this tapeworm there are specimens from Abildgaard's time in the collection of the Agricultural College. I have also found it in great numbers in a bustard from Jylland, which died (in 1860) in Kjærbölling's Zoological Garden; and it seems in general to occur plentifully in this bird. On examining the head, I found on the retracted proboscis fourteen unidentate hooklets of 0·024–0·026 millim. in length, with a proportionally very long shaft. *Tænia stylosa*, *T. fringillarum*, and several hitherto undescribed species of tapeworms in *Scolopax rusticula* and *Cursorius isabellinus* have hooklets of a similar form. In the joints the oval strongly refractive organ (cirrus-vesicle?), which is also reproduced in Bloch's figures, is particularly striking. The generative organs were nowhere protruded; but the sexual orifices are undoubtedly uniserial, although not very large. No ova occurred.

Together with this tapeworm, Bloch found in *Otis tarda* a second species of *Tænia*, which he likewise figured. He called it *Tænia articulis conoideis*, and stated that he had found it in many kinds of birds, among others in several species of ducks. This, however, has no very prominent peculiarities, and might consequently be easily confounded with other tapeworms. Rudolphi referred it to *T. infundibuliformis*, Goeze, and likewise found it in bustards. But the worms in question, as preserved in the museum at Berlin, are, as I have had the opportunity of convincing myself, different from the *T. infundibuliformis* which occurs in the common fowl, and have uniserial sexual orifices, like *T. villosa*. As neither heads nor joints with ova were to be found, I am not at present in a position to give a more complete character of it. In

* Vermium intestinalium, præsertim Tæniæ humanæ brevis expositio (Lipsiæ, 1782), p. 54, tab. 3. figs. 58–63.

† Entozoorum sive vermium intestinalium historia naturalis, vol. ii. part 2 (Amstelodami, 1810), p. 126.

‡ Icones Helminthum (Viennæ, 1824), tab. 15. figs. 9–13.

§ Schmalz, xix. tabulæ anatomiam Entozoorum illustrantes (Dresdæ et Lipsiæ, 1831), tab. 3. figs. 1–6.

|| Hist. Nat. des Helminthes (Paris, 1845), p. 603.

the Vienna catalogue* it is stated that the tapeworm was found once in seven times in *Otis tarda*, and it is referred to *T. infundibuliformis*.

In the above-mentioned bustard from Kjærbölling's zoological garden there was, besides *T. villosa*, another in many respects very remarkable tapeworm, to the number of several hundreds. As it is not very different in breadth from *T. villosa*, I first observed it when, long after collecting it, I undertook a closer examination of the latter worm. It was 20–30 millims. in length. There was no head with the usual organs of adhesion, and I therefore thought at first that it had been lost. Probably, however, that is not the case, partly because there is no trace of lesion to be seen, and partly, which is of great importance, because in all specimens the anterior extremity behaves in the same peculiar fashion, having a very singular structure. The number of joints varied from thirty to rather more than one hundred; but the length of the tapeworm held no proportion to this number. The six or seven joints which constitute the anterior part present in all the same appearance: they are, like the rest, compressed; but both their posterior angles stand out at the sides as saddle-shaped membranous fingers, which are largest upon the middlemost of these joints, but become lost behind, the superior joints passing evenly into the following ones. In the middle region of the worm the male sexual apparatus was generally well developed; and along one margin the sexual organs showed themselves protruding upon a larger or smaller number (up to about twenty) of segments, most strongly upon the middlemost of these, whilst they were more or less retracted upon the foremost and hindmost of them. The sexual organ (the protruded spermatic duct) is cylindrical, comparatively large, namely 0·046 millim. in diameter, and as much as 0·5 millim. in length; its surface has a readily perceptible covering of fine spines, in regularly crossing rows. If the spermatic duct be traced into the joint, it is seen to bend backward and form a loop. From the sexual orifice an elongated oval sac extends forward. In the posterior part of the joint two pretty sharply defined roundish organs are observed, and between these a third, less considerable one. The joints now increase in size posteriorly; and in the posterior there were, in several of the worms, thinly membranous round ova, with hooked embryos of 0·014–0·016 millim. in length; these joints, which were more elongated, had a dilatation

* Westrumb, De Helminthibus acanthocephalis. Commentatio historico-anatomica adnexo recensu animalium, in Museo Vindobonensi circa Helminthes dissectorum, et singularum specierum harum in illis repertarum (Hanoveræ, 1821), p. 78.

upon one side or the other, in which especially the ova were collected.

A single younger specimen, of a little more than 10 millims. in length, in which there was not yet any trace of generative organs, furnished some elucidation of the mode of development of the joints. The anterior extremity of the worm presented the same characters as in the more developed specimens; it had exactly the same appearance, and was only a little smaller; but behind it the breadth diminished, so that the whole of the posterior region was very small, only 0·1 millim. broad, although already distinctly and throughout quite regularly divided into joints, the number of which amounted to about 110. Now, considering that the number of joints in the more developed worms was smaller in proportion as the development of the sexual apparatus and therewith the enlargement of the joints had advanced forwards, it would seem certain that the formation of all the joints takes place before the sexual organs begin their development, and that their development subsequently advances from behind forwards, whilst the posterior joints are successively thrown off as they reach maturity.

As this tapeworm cannot be referred to any known genus, I will propose to call it *Idiogenes Otidis*. I assume that the anterior region furnished with finger-like processes may be regarded as the head or scolex. The ova exactly resemble those which occur in several species of *Tænia*; but the mode of development of the joints differs from the usual mode.

If we examine Bremser's fig. 13, and Nitzsch's figs. 2, 3, 5, and 6, as cited, in which joints of *T. villosa* with protruded sexual organs and more or less distinct indications of the internal sexual apparatus are represented, the supposition will be forced upon us that a confusion of this tapeworm with *Idiogenes Otidis* may have taken place; and, with regard to Bremser's figure, it appears to me very probable that it belongs to *Idiogenes*. With regard to Nitzsch's figures, it might in such case be assumed that the generative apparatus of *Idiogenes* was drawn in the joint of *T. villosa*; at least I have never met with joints of *T. villosa* with sexual apparatus of this appearance. It is possible that Nitzsch might have been misled by Bremser's figure, and sought, by his somewhat diagrammatic figures, to bring about an agreement: and with regard to this, it may be remarked that it is difficult to obtain a complete and coherent specimen of *T. villosa*, in consequence of the interknotting which has already been referred to, and the facility with which they are broken up into fragments.

EXPLANATION OF PLATE III. figs. 4–13.

Fig. 4. Anterior part of *Tænia villosa*, with the head (× 85).
Fig. 5. Circlet of hooks of the same (× 240).
Fig. 6. Single hooks of the same (× 920).
Fig. 7. Joints of the same (× 35).
Fig. 8. Joints of "*Tænia infundibuliformis*," from *Otis tarda*, in Rudolphi's collection (× 35).
Fig. 9. *Idiogenes Otidis* in a young stage (× 9).
Fig. 10. The same, more advanced in development (× 9).
Fig. 11. The anterior region of the same (× 18).
Fig. 12. Joints of the same, with generative organs (× 35).
Fig. 13. Ova of the same (× 240).

VII.—*On the Myology of* Bradypus tridactylus; *with Remarks on the general Muscular Anatomy of the Edentata.* By ALEXANDER MACALISTER, Demonstrator of Anatomy, Royal College of Surgeons, Ireland, Professor of Anatomy, Royal Dublin Society*.

THE muscular anatomy of the Edentata is of particular interest when considered in connexion with the curious habits of many of the order, as well as when we consider it in connexion with the zoological affinities of the group; and attention has been directed of late to the subject by a number of papers by various anatomists. Through the kindness of Prof. Haughton, I have been enabled to make a very careful dissection of (1) a very fine young specimen of Aï (*Bradypus tridactylus*) and (2) four Armadilloes (*Dasypus sexcinctus*); and on these, with references to the notes of a former dissection of a Seven-banded Armadillo, I have founded the following remarks. The anatomy of the Aï has been made the subject of description by Süsemuhl†, Meckel‡, and Cuvier§, that of the Anteaters by Meckel‖, Pouchet¶, Owen**, and Rapp††; of *Orycteropus* by Cuvier, Humphry‡‡, and Galton §§; of Armadilloes by Cuvier, Meckel, and Galton. It may thus be seen how much has been hitherto done as regards the study of the myology of these animals. Most of these descriptions seem to be made

* Communicated by the Author, having been read before the Royal Zoological Society of Ireland.
† De Musculis in extremitatibus Bradypodis tridactyli. Berol. 1815.
‡ System der Vergleichenden Anatomie, 1828.
§ Leçons d'Anat. Comparée, 1835.
‖ Anat. des zweizehigen Ameisenfresser. Archiv, v. 1819.
¶ Mémoire sur le grand Fourmilier. Premier livraison. 1867.
** On the Anatomy of the Great Anteater (Trans. Zool. Soc. 1854).
†† Anatomische Untersuchungen über die Edentaten. Tübingen, 1852.
‡‡ Journal of Anat. & Phys. ser. 2. vol. i. p. 290.
§§ Trans. Linn. Soc. vol. xxvi. p. 567.

with great care and accuracy; so that we are in a position to appreciate the special myological characters of the entire order. The specimen of Three-toed Sloth was in good condition, small; and, as many of its epiphyses seemed to be still cartilaginous, it was evidently a young animal.

On removing the skin from the back and side, very few platysmal fibres were visible; indeed the only portions of the panniculus carnosus present were a few scattered weak fasciculi at its lower or abdominal end, and a very few sparse bundles in the neck, much weaker than I have found in *Dasypus sexcinctus*.

The trapezius was a thin muscle, rather smaller than usual, arising from all the cervical spines with the exception of the first, and from the upper six of the dorsal spines; it was inserted into the scapular spine for its whole length, and into the acromion process. I could trace no fibres into the rudimental clavicle, although such an arrangement is described by Meckel both in this animal and in the Anteater; similarly, I found no clavicular fibres in the *Dasypus sexcinctus*, and in this respect agree with the observations of Mr. Galton, who says that in *Orycteropus* also no clavicular fibres exist. This muscle in the Aï is undivided, as also in *Orycteropus*; but in the Armadillo it is split distinctly into upper and lower portions. Meckel in his description assigns to this muscle a much more limited range of origin than that which I have found.

The rhomboideus is small and single; it arises from the last cervical and the upper three dorsal spines. Its insertion is normal. There is no trace of an occipital slip; but in *Dasypus* I found a true occipito-scapular slip largely developed. The same condition occurs in *Orycteropus*; but, with the exception of a slight differentiation in direction, it is not separable into true major and minor portions (Galton). In the Two-toed Anteater its arrangement, according to Meckel, is similar to that in the Aï.

I found no levator claviculæ or trachelo-acromial (omo-atlantic of Prof. Haughton); it is described as existing in the Orycterope under the name of cervico-humeral (Humphry), acromio-basilar (Galton); and it is likewise present in the Armadillo, and inserted into the clavicle.

The levator scapulæ is not distinct from the serratus magnus, and hence Meckel describes it as non-existent; but as we recognize any cervical prolongation of the serratus magnus as a levator scapulæ (for in truth the latter in its most perfect condition is nothing else than a neck prolongation of the former), so it is probably more correct to say that the levator scapulæ segment of the serratus arises from all the cervical

transverse processes below the sixth, and is inserted into the superior angle of the scapula inseparable from the rest of the serratus; it is more separate in the Armadillo, but less separate in the Orycterope.

The splenius is distinct, moderate in size, arising from the spines of the third, fourth, fifth, and sixth cervical vertebræ, and is inserted into the transverse process of the atlas; this part seems to correspond with the splenius capitis of other animals, but it has no occipital attachment; the second part, or splenius colli, arises from five spines below the last-named muscle, and is inserted into the transverse processes of the second, third, fourth, and fifth cervical vertebræ.

The complexus arises from the transverse processes of all the cervical vertebræ, and is inserted into the occipital bone; it has no biventral portion, and showed no traces of tendinous intersections.

The semispinalis colli, longissimus dorsi, multifidus spinæ, recti capitis postici, obliqui capitis, and rectus capitis anticus major were not remarkable in any respect. The intercostals were not divisible into distinct strata; and I saw no traces of transversi thoracis anterior or posterior. Longus colli was large, but exhibited nothing unusual in its attachments.

Serratus magnus, when separated artificially from the levator scapulæ, arises from the eight superior ribs (Meckel says seven); its insertion is normal, into the lower two-thirds of the vertebral costa of the scapula; it is undivided, but thin in the middle, but is separated into two parts in *Dasypus*. It is not split in the Orycterope.

Omohyoid is absent in the sloths, as Cuvier and Meckel mention: the former refers to its existence in the Anteater; but Owen does not mention its presence in the Great Anteater, and it is absent in the Armadillo, as Galton very correctly observes, and in the Orycterope.

Sterno-cleido-mastoid arises from the front of the sternum, from the first rib, by a few aponeurotic fibres, and from the inner end of the soft rudimental clavicle; the latter origin is extremely slight, barely sufficient to justify the middle particle of the name; it is not distinctly continued over the great pectoral, but the muscles of each side are connivent in the mesial line; it is inserted by two slips into the paramastoid process; the muscle is split into true sterno- and cleido-mastoid portions in the Six-banded Armadillo and in all the Anteaters.

Sterno-hyoids and sterno-thyroids were normal, as also were the digastric (which, as is often the case, had but one belly), mylohyoid, thyrohyoid, and hyoglossus. The other muscles of the neck were not examined.

Pectoralis major, a large and flat muscle, arises from the front of the sternum, continuous with its fellow of the opposite side, from the cartilages of the six upper ribs, and from the inner end of the rudimental clavicle; from this origin it is inserted into the pectoral edge or outer lip of the bicipital groove. It does not extend to the abdomen, as is the case in *Dasypus* (Galton); and it likewise differs from the pectoral in that animal by extending to the clavicle, which is not the case in the Armadillo or in the Orycterope. The pectoral in the Aï is not connected with the latissimus dorsi or with the external oblique, but is closely attached to the deltoid.

Pectoralis minor was absent in *Bradypus*, as stated by Meckel. Cuvier, in his plate of this animal, calls the next muscle by this name, erroneously, I believe. It is likewise absent in the Anteaters and in the Armadilloes. Galton considers the muscle described by Meckel in the Armadillo as pectoralis minor to be in reality subclavius. In *Orycteropus* a pectoralis minor does in reality exist, described by Humphry and Galton.

Subclavius, a large muscle, arising as usual from the first rib, passes upwards and outwards to be inserted into the under side of the acromion process, and by a few fibres into the clavicle. In the Orycterope this muscle is large and sternal in its origin; and its insertion, in the specimens examined by Mr Galton, was into a sesamoid bone beneath the acromio-clavicular joint, imbedded in the fibres of origin of the deltoid. It is present and large in the Armadillo, but absent in the Tamandua (Rapp, Galton), and in the Great Anteater (Pouchet) and Two-toed Anteater (Meckel); but it is present and small in the Two-toed Sloth (Galton).

Pectoralis quartus (latissimus dorsi secundus) arises from the seventh and eighth ribs at the junction of their bony and cartilaginous portions; it is inserted into the outer or pectoral lip of the bicipital groove. This muscle I consider to be a fourth pectoral; and its insertion is, I think, sufficient to determine this relation; it is, however, often regarded as a part of the latissimus dorsi, and has been described as a second latissimus in the Seal and several other animals. Galton, in speaking about the latissimus dorsi in *Dasypus sexcinctus*, says that "certain muscular fibres take origin from the ribs between the fifth and ninth inclusive, anterior, but close, to those costal elements of the latissimus dorsi already described as arising from the same ribs, and pass straight upwards to that portion of the broad terminal tendon of the pectoralis major which has the highest insertion into the humerus;" this he considers possibly a modified "Achselbogen;" and he states very pro-

perly that it coexists with the dorsi-epitrochlear muscle, and thus can scarcely be, as Mr. Wood suggests, an imperfectly developed slip of the dorsi-epitrochlear muscle. This muscle I found in *Cebus capucinus* (Proc. Nat. Hist. Soc. Dublin, April 1866) passing from the cartilages of the eighth, ninth, and tenth ribs to the capsular ligament of the shoulder-joint. A similar muscle was described by Mr. Mivart in *Cercopithecus sabæus* (Proc. Zool. Soc. 1865, p. 44). I have likewise seen it in *Macacus nemestrinus* and *sinicus*. This muscle is described and figured by Mr. Wood as an anomaly in human anatomy (Proc. Royal Soc. 1866, p. 231, and fig. 1); it is described by Zenker in Amphibian reptiles as brachio-abdominalis (Batrachomyologia, p. 39), and by Duvernoy as chondro-epitrochlear in many animals. Prof. Huxley has also given to it the name of costo-humeral. I have found it present in the Seal, Opossum, *Phalangista, Macropus giganteus*, Wallaby, Otter, and as an anomaly in man. Dugès applies to it the name abdomino-humeralis, and Klein humero-abdominalis. It is strongly marked in the Frog, *Pipa americana* and *Bufo cinerea*, and in *Lacerta viridis* (closely connected to the great pectoral); but it does not seem to exist in *Iguana tuberculata*, and is not mentioned in Mr. Mivart's careful description of this species. Its affinities seem certainly to be pectoral, and it seems to be an additional posterior member of that group of muscles; and its rudiment, I think, is the human "Achselbogen" of Langer, as supposed by Mr. Galton.

The rectus thoracicus lateralis arose from the third, fourth, and fifth ribs, and was inserted into the first rib; it lay superficial to the serratus magnus. This was the only thoracic rectus present, as there was no superficial sternalis brutorum or rectus sternalis, nor was the rectus abdominis continuous with it. It was quite separate from, but internal to, the scaleni muscles. A muscle corresponding to this was described as an anomaly in human anatomy by Mr. Wood and myself some time ago, and I have since met with several instances of it in the dissecting-room; and a similar muscle I also found in *Macacus sinicus* and *nemestrinus*, and very distinct in a fine Bengal tiger; but in them the rectus abdominis was continuous with the muscle, which is not the case in *Bradypus*. The insertion of this muscle was a little external to the origin of the subclavius; and in this respect it corresponded closely to the arrangement in *Orycteropus capensis*, in which the subclavius origin almost touches the prolonged rectus abdominis—a condition described by Meckel and Galton. We can thus determine the homologies of this lateral rectus, and find it to be nothing but a prolonged or detached slip of the rectus abdominis, displaced outwards or lateralized from its origin.

The latissimus dorsi arises from the lower dorsal spines through the medium of the lumbar fascia from the lower five ribs, and is inserted as usual into the inner bicipital lip of the humerus. Meckel mentions that it is divided into two parts; but one of these is the pectoralis quartus described above. In the Anteater the origin of this muscle is described as being purely costal and fascial. In the Armadillo its origin is extensive and normal. It is not so closely connected to the teres major in the Aï as in the Great and Two-toed Anteaters, in both of which it is described as being closely joined to that muscle.

The deltoid muscle is small, triangular, and not clearly segmented; it arises from the acromion process and from the scapular spine, and is closely connected to the trapezius on the one side, and to the great pectoral on the other; its insertion is into the middle fourth of the outer side of the humerus. Its area of insertion is not so extensive as is stated by Meckel; but allowance may perhaps be made for the youth of the present specimen. Meckel mentions that it gives off an accessory head to the biceps, which we did not find in our specimen. In the Armadillo the deltoid is divisible into acromial, clavicular, and spinous or scapular parts, as described by Galton and Meckel. In *Orycteropus* it is likewise trifid according to Cuvier and Galton, bifid according to Prof. Humphry. It is also bifid in the Anteater.

The supraspinatus muscle was normal in origin and insertion, as is the case in *Orycteropus*, *Myrmecophaga*, *Dasypus*, and others. The infraspinatus is likewise regular; and the teres minor is absent, or, if present, its germ is fused with the infraspinatus. A true teres minor is present in the Armadillo, Orycterope (Humphry, *loc. cit.* p. 300; Galton, p. 574), and Anteater. Meckel, indeed, mentions a teres minor in the Aï, but it seems to be the next muscle, and not a true teres minor.

Subscapulo-humeral, a small muscle on the subscapular aspect of the long head of the triceps, arises from the upper portion of the axillary margin close to the glenoid cavity, and is inserted below the lesser humeral tuberosity. It is quite separate, in the Aï, from the subscapularis. This muscle was described by Wenzel Gruber (Abhandlung aus die menschlichen und vergleichenden Anatomie: Petersburg, 1854, p. 109), by Mr. Wood and myself as an anomaly in human anatomy (Proc. Roy. Irish Acad. April 1866, and Med. Press and Circular, vol. iii. p. 79). I have found it in many animals, as stated in my former paper, to which I have to add the Tiger and the Aï.

The subscapularis was normal, as was also the case in *Cho-*

lœpus, *Dasypus*, *Orycteropus*, and the Anteaters. The teres major is very large and quite separate from the latissimus dorsi, as it is in the Orycterope and Armadillo, not connected to it as in the Great Anteater (Pouchet) or the *Myrmecophaga tamandua* (Rapp).

Coraco-brachialis is small, and inserted into the upper fourth or perhaps nearly the upper third of the humerus; it is undivided, and represents, according to Mr. Wood, the middle rather than the short coraco-brachial muscle. The long form occurs in the Orycterope (Humphry); in one specimen of this animal, however, Galton describes a rudiment of the short form: it is present also, in its long variety, in *Myrmecophaga jubata* and *tamandua*; the middle variety represents it in *Cholœpus didactylus*. In the two above-mentioned Anteaters, Messrs. Galton and Pouchet describe fibres from the root of the rudimental coracoid inserted into the outer part of the inner tuberosity. This condition is described by Mr. Galton as occurring also in *Macropus ruficollis* and *giganteus*; and I remarked it in a Wallaby and also in the shoulder of *Globiocephalus svineval* (Proc. Zool. Soc. 1867, p. 481). In the Armadillo both the short and long forms exist, as Mr. Galton correctly describes.

The biceps is a double muscle, and may be regarded as consisting of a humeral and a scapular portion. The more superficial or humeral arises from the anterior surface of the humerus internal to the deltoid, but unconnected with that muscle; its origin extends for about one-half of the anterior surface of the bone, and it overlaps the scapular head; this muscle passes downwards perfectly separate from the scapular biceps, and is inserted into the tubercle of the radius. It is accurately described by Meckel; but in his case an accessory head was received from the deltoid—a condition of which I could not find a trace. This humeral head to the arm-biceps does not exist in the Armadillo, Anteater, or Orycterope; but it is a common anomaly in human anatomy, occurring, according to Theile, once in every eight subjects (Encyclopédie Anatomique, vol. iii. p. 217)—a proportion which I found to exist in the dissecting-room of the Royal College of Surgeons, Ireland, during the session 1866-67 (Proc. Royal Irish Acad. 1867). The accessory deltoid head described by Meckel has its counterpart in another anomaly described by me in the same paper—the fifth variety of the biceps therein recorded, in which the biceps arose by a fleshy tongue from the deltoid, and did not possess a long head: this, as we shall presently see, is a close approach to the "Sloth" condition. A coracoid and humeral biceps exists in *Vespertilio*

and *Pteropus javanicus**. The same arrangement occurs in many birds, except the Struthionidæ and some of the Natatores. The humeral head also appears in the human leg as an element in the biceps flexor cruris.

The scapular biceps arises from the upper part of the scapula, immediately above the glenoid cavity, external to the root of the coracoid process; it passes over and does not pierce the capsular ligament of the shoulder-joint, and is, as before mentioned, not at all connected to the last muscle. It is inserted into the ulna by a distinct strong tendon. This gleno-ulnar biceps is not bound down into a groove at the upper part of its course, as in *Dasypus*: in that animal its insertion is both radial and ulnar. In two Armadilloes dissected by me there was no origin from the coracoid process; but in one dissected during April 1868 a slender band sprang from that process, and so the muscle was a true biceps. The biceps has a single head in the Two-toed Anteater, but is radio-ulnar in its insertion. It has a glenoidal and a deltoidal origin in the Orycterope, and is purely radial in its insertion. In *Myrmecophaga tamandua* it has one head from the glenoid cavity, one from the coracoid process arising in common with the coraco-brachialis, and a third from the humerus. In the Great Anteater, Pouchet describes two heads, glenoidal and coracoidean, the latter being closely united to the coraco-brachialis at its origin. (For some notes on these flexors see Journ. of Anat. and Phys. 1868, p. 285.)

The brachialis anticus arises from the anterior and inner side of the humerus, and is inserted by equal tendons into the radius and the ulna, its radial attachment being slightly connected to the radial insertion of the humeral part of the biceps, and its ulnar one being placed behind the insertion of the gleno-ulnar muscle. This muscle seems not to have a separate existence in the Anteaters, except in the Great Anteater, in which Pouchet described it as present. Rapp describes it as undeveloped in *Myrmecophaga tamandua*; and Meckel says it has not a separate existence in *Myrmecophaga didactyla*. In *Orycteropus* it receives a slip from the biceps (Humphry), and sends a small slip to the radius (Galton). Meckel describes it as being purely ulnar in its insertion in *Bradypus tridactylus*. In the Armadillo it is very large, and is purely ulnar in its insertion.

The triceps arises by a scapular and two humeral heads separated as usual by the musculo-spiral nerve. In the Ant-

* Prof. Humphry describes the biceps as possessing two coracoid heads in *Pteropus Edwardsii*, and without a humeral head (Journ. of Anat. and Phys. vol. iii. p. 303).

eater Meckel describes two scapular heads, and one humeral. Two scapular heads likewise exist in *Dasypus*—one a long head proper, the other a more superficial and expanded origin; from these the dorsi-epitrochlear is quite distinct; and thus, with the two humeral origins, we have five extensor muscles on the back of the arm. In the Orycterope there are four heads, two humeral and two scapular (Galton). Three scapular origins are described by Prof. Humphry.

The anconeus externus is distinct and large; the epitrochleo-anconeus (Gruber*) is large and underlies the flexor carpi ulnaris, and crosses over the ulnar nerve; this muscle arises from the inner condyle, and its fibres pass transversely outwards to the olecranon process. It is present in the Orycterope (Cuvier, Humphry, Galton), in the Tamandua (Rapp), in *Myrmecophaga jubata* (Pouchet), *Dasypus sexcinctus*, *tricinctus* (Gruber), *M. didactyla* (Gruber), *Manis*, *Cholœpus didactylus* (Galton), *D.* (*Tatusia*) *novemcinctus* (Galton).

The pronator teres is large, as in most of the Edentata, and arises from the inner condyle of the humerus. It soon separates into two portions near its insertion; and these occupy the lower half of the radius and the anterior surface of the wrist-joint. In the Armadillo its insertion is also to the lower part of the radius, occupying about one-half of that bone. It is similar and undivided in the Anteater and Orycterope. The median nerve is underneath it in all; and there is no trace of a coronoid head in any of these. (Journal of Anat. & Phys. 1867, p. 9.)

Pronator quadratus is a small muscle occupying the lower sixth of the forearm; its fibres run in their usual ulno-radial course at an angle of about 60° with the shaft of the radius. Meckel says that this muscle is smaller in the Aï than in any other mammal, and that it occupies only one-eighth of the forearm; but this did not exactly describe the appearance in our specimen, for, though small, it was not quite so insignificant as the great German anatomist found it, as in our instance it was at least as long as broad. I did not find a trace of it in the Armadillo, as Galton and Meckel observe; and it seems likewise to be absent in *Myrmecophaga didactyla* (Meckel). It exists, however, in *M. jubata* (Pouchet), *M. tamandua* (Rapp), and *Orycteropus*, in which Prof. Humphry describes it as small, and Mr. Galton as filling the whole interosseous space of the forearm, as well as the anterior face of the radius and ulna.

Flexor carpi radialis is a small muscle, and passes from the

* Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg, sér. 7. vol. x. p. 5.

inner condyle to the metacarpal bone of the first finger, and to the trapezium bone at its base. In the Orycterope Mr. Galton mentions that it arises from the *external* condyle (a misprint, I suppose, for *internal*), and that it is inserted into a sesamoid bone and into the styloid process of the radius: these peculiarities of insertion were described by Prof. Humphry. In the Armadillo it is inserted into the outer of the bones of the second row of the carpus (trapezio-trapezoid of Mr. Galton).

Palmaris longus is larger than the last, and has a corresponding origin; its insertion is into the palmar fascia, and into the pisiform and unciform bones. It is quite separate from the flexor sublimis digitorum, although in *Dasypus* they are closely connected—an arrangement described by Theile as an anomaly in human anatomy, and noticed (Proc. Royal Irish Acad. Dec. 9, 1867) as the thirteenth variety of the palmaris by myself. In the Orycterope the same fusion of palmaris and superficial flexor occurs (Humphry). Rapp describes it as absent in *M. tamandua*; but the "Spannmuskel" recorded by him is in reality only a variety of it displaced in its origin. In the *Myrmecophaga didactyla* Meckel described the palmaris as united to the flexor carpi ulnaris—a condition which I have also found as an anomaly in human anatomy (variety 15 in the paper above mentioned).

Flexor carpi ulnaris arises by two heads, from the internal condyle and from the olecranon process—its two origins being separated by the ulnar nerve, and overlying the anconeus internus; its insertion is into the pisiform and unciform bones, annular ligament, and base of third metacarpal bone. It has no condyloid head in the Armadillo and Orycterope (Galton), but has two portions in the latter, deep and superficial, but both ulnar in origin. It is very complex in *M. didactyla* (Meckel), being quadrifid, three being true ulnar flexors and one palmaris longus: the three former may represent the condyloid head of the Aï, and the two ulnar origins in the Orycterope; and this would give us a clue to its complexity of arrangement.

In the Aï, in consequence of the singular method of progression and mode of life of the creature, the digits are closely flexed, with the prominent hooked nails incurved to the palms; and while the flexor muscle of the digits is undivided, it is impossible, without tearing, to extend these even to a right angle with the palm. These tendons are bound down at the wrist by an enormously strong annular ligament, which passes from the scaphoid and trapezium bones to the unciform, pisiform, and third metacarpal bones. Each flexor tendon has a special fibrous and synovial sheath, underneath which it travels. The palmar fascia is in reality a continuation of this

ligament; and into it the palmaris-longus tendon is inserted. On slitting up this structure, the flexor digitorum is exposed. This muscle is single, and plays the part of flexor sublimis, flexor profundus, and pollicis. It arises from the inner condyle of the humerus, from the front of the radius, ulna, and interosseous membrane; all its fibres unite to form one mass, which ends in three very strong tendons passing to the last phalanges of the three digits. Each tendon is bound down by an enormously strong sheath, and when examined seemed to be composed of two laterally united halves, as a groove extended in the centre of their distal ends for nearly one-fourth of their thickness. The Aï resembles the Orycterope in having no sesamoid bone in the palm, but differs from it in being devoid of all traces of lumbricales. Each tendon has several synovial vincula or retinacula binding it in its place. No sesamoid bone exists in the Tamandua, the Two-toed, or the Great Anteater; but in the Armadilloes they exist in *D. sexcinctus*, *tricinctus*, *gigas*, *Chlamyphorus truncatus*, as also in *Echidna hystrix* and *Ornithorhynchus*.

We could find no true supinator longus in the Armadillo; but it is well developed in the Tamandua and the Orycterope, and in the Aï proportionally best of all, and split into two strata, as was the case with the pronator teres; the longest of these was inserted into the lower extremity of the radius, and by a few fibres into the external lateral ligament of the wrist. In the Two-toed Anteater it is similarly divided; but it does not seem to be present in the *M. jubata*; at least Pouchet does not mention its existence.

The supinator brevis was small and characteristic, pierced by the posterior interosseous nerve. Its origin was purely humeral, and its insertion, as usual, was radial. Its position is similar in the Armadillo; and its nervous relation appears constant in these animals. It seems to be larger in the Orycterope, as it extends in that creature for one-half of the radius. It exists likewise in the Great, the Two-toed, and the Tamandua Anteaters.

The extensor carpi radialis is a single muscle with a double tendon inserted into the first and second metacarpal bones. It has two tendons, according to Mr. Galton, in the Orycterope—one, according to Prof. Humphry. In this animal the former author observes that the tendon representing the extensor carpi radialis brevior seemed to be the more direct continuation of the original muscle; but in *Bradypus* there is no difference between the parts of the muscle furnishing the broad flat tendon. In *Cholœpus* it is circumstanced similarly, and in the Anteaters and Armadilloes it is the same.

Extensor carpi ulnaris arises from the outer condyle of the humerus, and is inserted into the third metacarpal bone. In the Armadillo it has an ulnar origin, and is inserted by the intervention of a sesamoid bone into the base of the fifth metacarpal bone. In the Orycterope its insertion is into the fourth and fifth digits; in the Anteaters, Two-toed and Tamandua, its insertion is similar.

Extensor digitorum communis is an exceedingly weak muscle arising from the outer condyle of the humerus, and inserted into the dorsal aponeurosis of the hand, dividing into weak fascial slips traceable along the dorsum of each of the two inner fingers; the third seems deprived even of this semblance of an extensor. In *Cholœpus didactylus* the tendon goes to both digits; the tendons of this muscle are much more distinct in *Orycteropus*, *Dasypus*, and *Myrmecophaga*, and seek an insertion usually into the last phalanges of the digits.

Extensor ossis metacarpi pollicis arises from the middle of the back of the ulna, and is inserted into the inner metacarpal bone at its base. This muscle does not seem to exist in the Two-toed Anteater; but it is present in *M. jubata*, in the Orycterope, and in the Armadilloes.

Extensor indicis is a small muscle, and the only representative of the second series of extensors. It arises from the lower extremity of the ulna, and is inserted into the base of the first phalanx of the first digit. This muscle exists in the Orycterope, in which animal it is inserted into the index and middle digits; in the Armadillo it goes, as in the dog, into index and pollex. The extensors of the first and second pollicial internodes, together with those of the ring- and little finger, were completely obsolete.

The short muscles of the hand are:—Abductor primi digiti, a short flat band passing from the scaphoid bone and annular ligament to the first phalanx of the inner digit; on raising this and the flexor tendons, I could see no traces whatever of palmar interossei. Extensor brevis digitorum manus, a small muscle on the back of the hand, which seems to contain the displaced germs of the dorsal interossei; its tendon joins the aponeurosis of the extensor digitorum longus, and is inserted [illegible] with it.

In the dissection of the pelvic limb, the abdominal muscles displayed no particular features of interest. The external oblique did not ascend as high as it is represented in the other Edentates; and the rectus was, as before mentioned, cut off from its thoracic segment.

Gluteus maximus, a small, superficial triangular muscle, arises from the posterior border of the ilium, from the side of

the sacrum, and is inserted into the outer part of the femur, immediately below the great trochanter. It is much smaller than its homologue in the Anteater, Armadillo, and Orycterope, and is easily separable from the biceps, which does not seem to be the case in the Orycterope (Trans. Linn. Soc. p. 589).

Gluteus medius and minimus were inseparably united, a condition which is described by Meckel: a similar fusion takes place in *Cholœpus*, *Dasypus*, and *Myrmecophaga jubata* and *didactyla*; Rapp, however, found them distinct in *M. tamandua*. Their attachments are as usual.

Tensor vaginæ femoris arises from the anterior fifth of the crest of the ilium, fleshy and tendinous, passes downwards into a line, about half an inch long, on the outer side of the femur below the great trochanter: this is the muscle to which Cuvier gives the name gluteus minimus; but its origin is on a plane superficial to the gluteus medius muscle, and anterior to the gluteus maximus. This muscle in the Armadillo is larger and more expanded; in that animal its insertion is not exactly into the bone, but into a tendinous sling passing from the third trochanter to the external condyloid ridge on the femur.

Pyriformis, quite distinct from the lower border of the gluteus medius, arises from the margin of the sacrum, and not from its anterior aspect, agreeing in this respect with *Dasypus*; it is inserted as usual. It has no fibres from the ilium, from which bone it takes its attachment in *Orycteropus*. It is not divided into segments.

Obturator internus, very small and displaced on account of the position of the lesser sciatic notch. Süsemuhl denies the existence of this muscle; and truly there is no muscle within the pelvis occupying the ordinary site of the inner obturator; but Meckel observes properly that the obturator internus lies beneath the obturator externus. This muscle is absent in *Dasypus* and in the Tamandua. The gemelli are both present, and about equal in size in the Aï, as also, according to Rapp, in the Tamandua and also in *Dasypus*. Both obturators and gemelli, however, exist in *Orycteropus*.

Quadratus femoris is present, but small. It seems to be absent in the Orycterope and the Anteaters; it is present, however, in the Armadillo. Meckel describes it as well developed in this animal. Obturator externus is normal as in all the Edentates.

Psoadiliacus is large and remarkable, unsegmented at its origin, which is as usual; its insertion is into the lesser trochanter and a ridge prolonged down the thigh for an inch be-

low this bone. The psoas parvus is present, but small. Some such continuation of the psoadiliac insertion seems to occur in the Orycterope.

Sartorius is a large flat muscle, and it arises from the anterior superior spine of the ilium and from the outer half of Poupart's ligament; of these origins the latter is the most important. Its fibres run downwards and inwards to be inserted into the inner side of the head of the tibia. This muscle includes the slip called by Cuvier "pubio-prétibien," or the rectus internus; the outer band is inserted into the femur, not the tibia. The origin ascribed to this muscle by Meckel (from the *external oblique* aponeurosis) will thus be seen to be quite accurate, despite the animadversions of the editor of Cuvier's 'Leçons orales.' This occurs in the Hare and Rabbit, as Krause very accurately describes. The sartorius is thus being moved inwards in this animal; and its displacement is completed in the Armadillo and Orycterope, in which the origin is distinctly internal to its usual site.

Pectineus muscle is composed of two parts, arising from the pectineal ridge on the os innominatum, and inserted into the femur for its entire length; the long superficial portion passes internal and nearly parallel to the sartorius, while the deeper part seems the true pectineus. This division is noticed by Cuvier, and seems likewise to occur in the Orycterope (Galton, Trans. Linn. Soc. p. 591). Gracilis is a continuation inwards of this same muscular stratum, and, arising from the pubic ramus and symphysis, passes downwards and inwards to be inserted into the inner condyle of the tibia.

Biceps femoralis is composed of two parts. One, the long head, arises from the tuber ischii and its ascending ramus and descending ramus of the pubis; it overlaps the adductors, and is separated from the femoral head by the great sciatic nerve. The femoral origin arises from the upper half of the back of the femur, on its outer side, and soon unites with the long head to be inserted into the head of the fibula. In the Armadillo there is no femoral head, nor in the Orycterope; but in the Tamandua and Two-toed Anteater this muscle has a true femoral head.

Semimembranosus and semitendinosus arise by a common tendon from the tuber ischii, and continue fused together for a short distance from their origin. They descend the thigh together, and are inserted into the tibia as usual, the semimembranosus passing to the upper part of the inner condyle and fascia of the leg*.

* By accident the notes on the adductor muscles have been lost; so I prefer leaving them deficient to filling the gap from memory.

The hip-joint is strengthened by three ligaments—a capsular, an ilio-femoral accessory, and a cotyloid ligament; but there is no ligamentum teres.

The muscles of the leg are:—

Tibialis anticus, which arises from the tibia and from a small part of the fibula about its middle, and is inserted by an undivided tendon into the middle of the base of the inner metatarsal bone; its fibular head is very diminutive. In *Orycteropus* it rises higher, to the ligamentum patellæ, and its tendon is split into two slips. Meckel mentions two separate origins in the Ai; but the tibial and fibular origins are not really separate. The Armadillo has but one head and one tendon; the Anteater has one tendon and two heads (Meckel).

Extensor digitorum longus arises normally from the heads of the tibia and fibula, and its origin is prolonged upwards to the femur; it ends in a weak tendon, which is inserted into the second metatarsal bone and into the dorsal aponeurosis of the digit. This peculiarity of insertion was noticed by Meckel, but its femoral origin was not. In the Orycterope the femoral origin exists, and its tendons are traceable to the toes. In *Dasypus* there is no condyloid head. Cuvier notices very accurately that in many of the Edentates this muscle has a femoral head.

Extensor hallucis proprius arises from the fibula and interosseous membrane and is inserted into the first phalanx of the first toe. It, like the preceding, is very small.

Extensor brevis digitorum arises from the lower extremity of the fibula and tibia, and is inserted into the first phalanx of the inner toe. This muscle is larger than the last, though short.

Peroneus longus arises from the outer condyle of the femur and from the upper part of the fibula; it passes downwards behind the outer malleolus, and is inserted into the outer metatarsal bone. In the Orycterope and Armadillo its tendon crosses the sole as it does in man. In the Anteater one of the peronei tendons closely resembles this.

Peroneus brevis arises as usual from the lower two-thirds of the outer side of the fibula. It is quite separate from the peroneus quinti, which runs along its posterior border and has its usual insertion into the outer metatarsal bone.

No peroneus quartus was present, nor any peroneo-calcanean muscle. The former exists in the Orycterope (Galton, p. 598). Peroneus quinti is distinct in the Armadillo.

Gastrocnemius arises by three heads, which are separate for their whole length. The two femoral heads arise from the posterior surface of either condyle, and are inserted into the calca-

neum. The soleus or fibular head arises from the upper fourth of the back of the fibula, and is inserted beneath the last named. The inner head is the largest, the external second in size, and the soleus smallest of all. The external is the largest in the *Dasypus*. There are no sesamoid bones in the origins of the muscle, as there are in the Tamandua and *Myrmecophaga didactyla*. Meckel, however, refers to the Aï as possessing one of these in its origin; and in the *Megatherium* one of these appears to have existed for the outer head of the gastrocnemius. The soleus does not arise from the middle of the fibula, as stated by Cuvier, but is limited to its upper portion alone.

The popliteus muscle is large and possesses a large sesamoid bone in its tendon of origin. As usual this muscle runs from the outer condyle of the femur to the back of the tibia. It does not seem to possess a sesamoid bone in the Tamandua, *Orycteropus*, or *Dasypus*.

Plantaris is a large pear-shaped muscle arising above the outer head of the gastrocnemius; and, passing down the posterior surface of the leg, it ends in a tendon which is inserted into the tendon of the flexor digitorum longus. This digital continuation seems to be characteristic of the plantaris in the Edentate animals, as it likewise exists in the Six-banded Armadillo and in *Orycteropus capensis*. Rapp makes no mention of it as present in the Tamandua; but possibly he may have confounded it with the gastrocnemius. This muscle seems to me to be larger proportionally in the Sloth than in any other animal that I have dissected.

Flexor digitorum longus arises from the posterior surface of the tibia, and is inserted into the three toes by three strong tendons. Its tendon is strengthened in the middle of the sole of the foot by the plantaris, which unites with it as a strong accessory. In the Oryctérope this muscle is fibular in its origin (Galton, p. 596), and sends a tendon to all the toes, even the hallux, and receives a slip from the tibialis posticus to assist it in forming the tendon for this digit. * This muscle is likewise mainly fibular in its origin in the Armadillo, and possesses a plantar ossicle.

Flexor hallucis longus, a very large muscle, arises from the fibula and interosseous membrane, passes downwards for a short distance, and unites with the last-described muscle to be inserted in common with it into the toes.

The tibialis posticus is very small and inconspicuous; it passes from the lower half of the back of the tibia, and is inserted into the inner cuneiform bone of the tarsus.

There are two musculi accessorii in the foot, one from the outer and the other from the inner surfaces of the calcaneum;

the former is inserted into the third-digit slip of the long flexor tendon; the latter, or true accessorius, is attached to the front of the two inner tendons, and is rather larger. The tendons for the toes are thus complex in their mode of formation; for plantaris and flexor digitorum, united with flexor hallucis and the accessorii, form but one common series of tendons. The flexors digitorum and hallucis first unite; these are joined by the plantaris; and the conjoined tendon receives the accessorii: thus the outer-toe tendon is formed by the outer accessorius and a slip from the common flexor; the inner receives the principal body of the flexor hallucis and a slip of the others, while the middle has one single tendon of composite origin.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Feb. 11, 1869.—Dr. W. B. Carpenter, Vice-President, in the Chair.

"On the Structure and Development of the Skull of the Common Fowl (*Gallus domesticus*)." By W. Kitchen Parker, F.R.S.

In a former paper (Phil. Trans. 1866, vol. clvi. part 1, pp. 113–183, plates 7–15) I described the structure and development of the skull in the Ostrich tribe, and the structure of the adult skull of the Tinamou—a bird which connects the Fowls with the Ostriches, but which has an essentially struthious skull.

That paper was given as the first of a proposed series, the subsequent communications to be more special (treating of one species at a time) and carrying the study of the development of the cranium and face to much earlier stages than was practicable in the case of the struthious birds.

Several years ago Professor Huxley strongly advised me to concentrate my attention for some considerable time on the morphology of the skull of the Common Fowl; that excellent advice was at length taken, and the paper now offered is the result.

A full examination of the earlier conditions of the chick's skull has cost me much anxious labour; but my supply of embryonic birds (through the kindness of friends)* was very copious, and in time the structure of the early conditions of the skull became manifest to me.

The *earliest* modifications undergone by the embryonic head are not given in this paper: they are already well known to embryologists; and my purpose is not to describe the general development of the embryo, but merely the skeletal parts of the head.

These parts are fairly differentiated from the other tissues on the fourth day of incubation, when the head of the chick is a quarter

* Dr. Murie is especially to be thanked for his most painstaking kindness in this respect.

of an inch (3 lines) in length; this in my paper is termed the "first stage." The next stage is that of the chick with a head from 4 to 5 lines in length, the third 8 to 9 lines, and so on. The ripe chick characterizes the "fifth stage;" and then I have worked out the skull of the chicken when three weeks, two months, three months, and from six to nine months old, the skull of the aged Fowl forming the "last stage."

During all this time (from their first appearance to their highly consolidated condition in old age) the skeletal parts are undergoing continual change, obliteration of almost all traces of the composite condition of the early skull being the result—except where there is a hinge, for there the parts retain perfect mobility.

Here it may be remarked that although the Fowl is only an approach to what may be called a typical Bird, yet its skull presents a much greater degree of coalescence of primary centres than might have been expected from a type which is removed so few steps from the semistruthious Tinamou, a bird which retains so many of its cranial sutures.

The multiplicity of parts in the Bird's skull at certain stages very accurately represents what is persistent in the Fish, in the Reptile, and to some degree in certain Mammals; but the skull at first is as simple as that of a Lamprey or a Shark, and, in the Bird above all other Vertebrates, reverts in adult age to its primordial simplicity —all, or nearly all, its metamorphic changes having vanished and left no trace behind them.

Although in this memoir I have no business with the Fish, yet all along I have worked at the Fish equally with the Bird, the lower type being taken as a guide through the intricacies of the higher; and here the Cartilaginous and the Osseous Fishes are never fairly out of sight. The Reptile, and especially the Lizard, has been less helpful to me, on account of its great specialization.

On the fourth day of incubation the cranial part of the notochord is two-thirds the length of the primordial skull, but it does not quite reach the pituitary body; it lies therefore entirely in the occipito-otic region. The fore part of the skull-base extends horizontally very little in front of the pituitary space; this arises from the fact that the "mesocephalic flexure" has turned the "horns of the trabeculæ" under the head. Thus at this stage the nasal, oral, and postoral clefts are all seen on the under surface of the head and neck of the chick. At this time the facial arches have begun to chondrify; but only the quadrate, the Meckelian rod, and the lower thyro-hyal are really cartilaginous; the other parts are merely tracts of thickened blastema or indifferent tissue.

In the second stage an orbito-nasal septum has been formed; the "horns of the trabeculæ" have become the "nasal alæ," and an azygous bud of cartilage has grown downwards between them; this is the "prænasal" or snout cartilage; it is the *axis* of the intermaxillary region. At the commencement of this second stage the primordial skull stands on the same morphological level as that of the ripe embryo of the Sea-turtle; at the end of this stage it has

become struthious; and now parosteal tracts (the angular, surangular, dentary, &c.) appear round the mandibular rod.

In this abstract I shall not trace the changes of the skull any further, but conclude with a few remarks on the nomenclature of certain splints, and as to the nature of the great basicranial bones.

Some years ago I found that certain birds (for instance the Emeu) possessed an additional maxillary bone on each side; knowing that the so-called "turbinal" of the Lizard and Snake was one of the maxillary series I set myself to find the homologies of these splints. Renaming the reptilian bones "prævomers," on account of their relation to the vomer, and supposing the feeble maxillaries of the Bird to represent them, I considered that the true maxillaries were to be found in those newly found cheek-bones of the Emeu and some other birds.

After discussion with Professor Huxley I have determined to drop the term "prævomer," and to call the supposed turbinal of the Lizard "septo-maxillary," and the additional bone in the Bird's face "postmaxillary."

In many Birds, but not in the Fowl, the "septo-maxillary" is largely represented—not, however, as a distinct osseous piece, but as an outgrowth of the true maxillary.

With regard to the basicranial bones, I have now satisfied myself that the "parasphenoid" of the Osseous Fish and the Batrachian reappears in the Bird as three osseous centres—all true "parostoses," as in the single piece of the lower types; these three pieces are, the "rostrum" of the basisphenoid and the two "basitemporals."

These three centres rapidly coalesce to form one piece, the exact counterpart of the Ichthyic and Batrachian bone; but just as this coalescence begins, ossification proceeds inwards from these "parostoses," and affects the overlying cartilage, the cartilage of the basisphenoidal region having no other osseous nuclei. This process of the extension inwards of ossification from a splint-bone to a cartilaginous rod or plate I have already called "osseous grafting"*.

In my former paper the basisphenoidal "rostrum" and "basitemporals" were classed with the endoskeletal bones; they will in the present paper be placed in the parosteal category, in accordance with their primordial condition.

By the careful following out of these and numerous other details I have corrected and added to my previous knowledge of the early morphological conditions of the Bird's cranium, and at the same time, I trust, have contributed to an enlarged and more accurate conception of the history and meaning of the Vertebrate skull in general.

March 18, 1869.—Dr. William Allen Miller, Treasurer and Vice-President, in the Chair.

"On the Structure of the Red Blood-corpuscle of Oviparous Vertebrata." By William S. Savory, F.R.S.

The red blood-cell has been perhaps more frequently and fully examined than any other animal structure; certainly none has

* See memoir "On the Shoulder-girdle and Sternum," Ray Soc. 1868, p. 10.

evoked such various and even contradictory opinions of its nature. But without attempting here any history of these, it may be shortly said that amongst the conclusions now, and for a long time past, generally accepted, a chief one is that a fundamental distinction exists between the red corpuscle of Mammalia and that of the other vertebrate classes—that the red cell of the oviparous vertebrata possesses a nucleus which is not to be found in the corpuscle of the other class. This great distinction between the classes has of late years been over and over again laid down in the strongest and most unqualified terms.

But I venture to ask for a still further examination of this important subject.

As the oviparous red cell is commonly seen, there can be no doubt whatever about the existence of a "nucleus" in its interior. It is too striking an object to escape any eye; but I submit that its existence is due to the circumstances under which the corpuscle is seen, and the mode in which it is prepared for examination. I think it can be shown that the so-called nucleus is the result of the changes which the substance of the corpuscle undergoes after death (and which are usually hastened and exaggerated by exposure), and the disturbance to which it is subjected in being mounted for the microscope. When a drop of blood is prepared for examination, little or no attention is given to the few seconds, more or less, which are consumed in the manipulation. It is usually either pressed or spread out on the glass slip, and often mixed with water or some other fluid. But it is possible to place blood-cells under the microscope for examination so quickly, and with such slight disturbance, that they may be satisfactorily examined before the nuclei have begun to form. They may then be shown to be absolutely structureless throughout; and, moreover, as the examination is continued the gradual formation of the nuclei can be traced. The chief points to be attended to are—to mount a drop of blood as quickly as possible, to avoid as much as possible any exposure to air, to avoid as much as practicable contact of any foreign substance with the drop, or any disturbance of it.

After many trials of various plans, I find that the following will often succeed sufficiently well. Having the microscope, and everything else which is required, conveniently arranged for immediate use, an assistant secures the animal which is to furnish the blood (say, a frog or a newt), in such a way that the operator may cleanly divide some superficial vessel, as the femoral or humeral artery. He then instantly touches the drop of blood which exudes with the under surface of the glass which is to be used as the cover, immediately places this very lightly upon the slide, and has the whole under the microscope with the least possible delay. Thus for several seconds the blood-cells may be seen without any trace of nuclei; then, as the observation is continued, these gradually, but at first very faintly, appear; and the study of their formation affords strong proof of their absence from the living cells.

The "nucleus" first appears as an indistinct shadowy substance, usually, but not always, about the centre of the cell. The outline of it can hardly, for some seconds, be defined; but it gradually grows

more distinct. Often some small portion of the edge appears clear before the rest. At the same time the nucleus is seen to be paler than the surrounding substance. Synchronously with this change—and this is noteworthy—the outline of the corpuscle (the "cell-wall") becomes broader and darker. What was at first a mere edge of homogeneous substance, becomes at length a dark border sharply defined from the coloured matter within. Thus a corpuscle, at first absolutely structureless, homogeneous throughout, is seen gradually to be resolved into central substance or nucleus, external layer or cell-wall, and an intermediate, coloured though very transparent, substance. But—and this is significant—these changes are not always thus fully carried out. It not seldom happens that the nucleus does not appear as a central well-defined regularly oval mass. Sometimes it never forms so as to be clearly traced in outline, but remains as an irregular shapeless mass, in its greater portion very obscure. Sometimes only a small part, if any, of an edge can be recognized, most of it appearing to blend indefinitely with the rest of the cell-substance. Sometimes it happens that in many corpuscles the formation of a nucleus does not proceed even so far as this. No distinct separation of substance can anywhere be seen, but shadows, more or less deep, here and there indicate that there is greater aggregation of matter at some parts than at others. Occasionally some of the cells present throughout a granular aspect. I have almost invariably observed, too, a relation between the distinctness of the nucleus and of the cell-wall. When the nucleus is well defined, the cell-wall is strongly marked; when one is confused, the other is usually fainter. This, however, does not apply to colour; on the contrary, when the nucleus is least coloured it contrasts most strongly with the surrounding cell. As a rule, the wall of the cell is more strongly marked than the nucleus.

It will of course be said that the nuclei are present all the while, but are at first concealed by the surrounding substance—the contents of the cell. Thus the fact has been accounted for, that the nuclei are not so obvious at first as they subsequently become. But I think a careful comparison of cells will show that those in which a nucleus may be traced are not more transparent than others which are structureless; and, moreover, when one cell overlaps another, the lower one is seen through the upper clearly enough to show that the substance of these cells is sufficiently transparent to allow of a nucleus being discerned if it exists. When a nucleus is fully formed, it hides that portion of the outline of a cell which lies beneath it. How is it, then, if the nucleus is present from the first, that the portion of the cell over which it subsequently appears is, for a while, plainly seen?

The success of the observation is of course influenced by numerous circumstances. The rate at which the nuclei form in the corpuscles varies in different animals. I have usually found that in the common frog they are more prone to form than in many other animals—quicker than in most fishes, or even than in some birds. But this does not seem always to depend upon their larger size; for in the

common newt the cells, which are larger than those of the frog, remain, as I have noticed, for a longer period without any appearance of nuclei. But even in the frog it can be satisfactorily demonstrated that the corpuscle is structureless.

I have found, too, that the observation succeeds best with the blood of animals which are healthy and vigorous. Thus the first observations upon fresh animals are usually the most satisfactory. After they have been repeatedly wounded or have lost much blood, the cells are more prone to undergo the changes which result in the production of nuclei.

Again, the formation of nuclei may be hastened, and their appearance rendered more distinct at last, by various reagents. Acids and many other reagents are well known to have this effect. The addition of a small quantity of water acts in the same way, but less energetically. It hastens the appearance of an indistinct nucleus, but interferes with the formation of a well-defined mass, so that, after the addition of water, neither the outline of the cell nor of the nucleus becomes so strongly marked as it often does without it. Exposure to air also promotes their formation; indeed, as a rule, the nuclei form best under simple exposure. Any disturbance of the drop, as by moving the point of a needle in it, certainly hastens the change; and perhaps it is influenced by temperature.

Sometimes, when the drop of blood has been skilfully mounted, the majority of cells will remain for a long while without any trace of nucleus; but, again, in almost every specimen, the nucleus in some few of the cells, particularly in those nearest the edges, begins to appear so rapidly that it is hardly possible to run over the whole field without finding some cells with an equivocal appearance.

It would follow, of course, from these observations that, if the living blood were examined in the vessels, the corpuscle would show no trace of any distinction of parts; and this is so. Indeed, in my earlier observations*, before I had learnt to mount a drop of blood for observation in a satisfactory manner, I examined, at some length, blood in the vessels of the most transparent parts I could select; and several observations on the web and lung of the frog and elsewhere were satisfactory. But still, when the cells were thus somewhat obscured by intervening membrane, one could not generally feel sure that the observation was so clear and complete, but that a faintly marked nucleus might escape detection. While, therefore, the result of observations on blood-cells in the vessels fully accords with the description I have given, I do not think that the demonstration of the fact, that while living they have no nucleus, can be made so plain and unequivocal as when they are removed from the vessels.

The question naturally arises, Why, then, does not a nucleus form in the mammalian corpuscle? But while it is accepted that the great majority of these corpuscles exhibit no nuclei after death, excellent observers still affirm their occasional existence; and I am convinced

* Made many years ago. Other observers have been unable to detect a nucleus in the living cells within the vessels.

that an indistinct, imperfectly formed "nucleus" is often seen; and the shadowy substance seen in many of the smaller oviparous cells after they have been mounted for some time is very like that seen under similar circumstances in some of the corpuscles of Mammalia. Many, too, affirm that these corpuscles do not exhibit that distinction of wall and contents which is generally described. It appears to me that this difference of opinion depends on the changes they are prone to undergo. How far the absence of a distinctly defined "nucleus" after death depends on their smaller size I am not prepared to say.

Many questions of course follow. For example, how far is this separation of the substance of a homogeneous* corpuscle into nucleus, cell-membrane, and contents to be compared to the coagulation of the blood? and how do the agents which are known to influence the one process affect the other? A still further and more important question is, How are these changes in the corpuscles, and in the blood around them, related? But in this paper I propose to go no further than the statement that the red corpuscle of all vertebrata is, in its natural state, structureless. When living, no distinction of parts can be recognized; and the existence of a nucleus in the red corpuscles of ovipara is due to changes after death, or removal from the vessels.

I cannot conclude this paper without acknowledging the great help I have received in this investigation from Mr. Howard Marsh, Demonstrator of Microscopical Anatomy at St. Bartholomew's Hospital.

MISCELLANEOUS.

Note on a new Hermaphrodite Chætopod Annelid. By G. Moquin-Tandon.

The group of Chætopod Annelida was long regarded as consisting entirely of unisexual animals. In 1857, Mr. Huxley made known the first exception to this general law in a new Annelid of the English coast, *Protula Dysteri*. A few years later, M. Pagenstecher, while staying on the shores of the Mediterranean at Cette, discovered the same fact in another species of the same family, *Spirorbis spirillum*. Lastly, a third fact of the same kind was observed by M. Claparède in a species of *Amphiglena* (*A. mediterranea*). This naturalist also confirmed the exactitude of Mr. Huxley's observations, and showed, by his investigation of a great number of Serpulea, that these cases of monœciousness are exceptional in this family.

I have discovered another example of hermaphroditism, but this time in a dorsibranchiate Annelid belonging to the genus *Nereis*. I believe that this species is new, and propose to name it *Nereis mas-*

* By the word homogeneous I do not mean to affirm that the substance of the corpuscle is of equal consistence throughout. The central may be the softest part of it. But I regard the corpuscle, in its whole substance, as "having the same nature."

siliensis. The following are its principal characters:—Middle antennæ short, subulate; lateral antennæ stout, shorter, composed of two joints—the basal thick, the terminal very small; the two superior tentacles long, reaching as far as the eighth segment, the two inferior shorter, but exceeding the antennæ; jaws strong, curved, presenting twelve teeth; no denticles; feet like those of *Nereis bilineata*. The body, which is 4·5 centimetres in length, has from sixty to seventy segments of a greenish-brown colour, marked with numerous vinose spots irregularly arranged.

This species occurs pretty frequently on the shore at Marseilles, among *Ulva*. It inhabits a membranous tube, constructed in a fold of the fronds of that plant, and is herbivorous. Of eleven individuals that I dissected, nine contained, pell-mell in the cavity of the body, spermatozoids and ova in different stages of development. The mature ova observed in the general cavity are yellowish, and 0·37 millim. in diameter. The free spermatozoids floating in the visceral fluid are composed of a bacilliform anterior part (head) 0·01 millim. in length by 0·0017 millim. in breadth, and of an excessively thin tail, 0·45 millim. in length. The tail is very different, both in its length and the nature of its movements, from the vibratile cilia of the cavity of the body.

The two individuals in which I did not detect hermaphroditism were females, and had the body filled with a great quantity of ova, all arrived at maturity.—*Comptes Rendus*, April 12, 1869, tome lxviii. pp. 869, 870.

The Poison-glands of Callophis intestinalis *and* C. bivirgatus. By A. Bernhard-Meyer.

The author has detected poison-glands in the above-mentioned snakes. He found them first in *Callophis intestinalis*, Laur. (*Elaps furcatus*, Schneid.), whilst engaged in an investigation of the position of the heart in serpents. He found the heart in this species thrown far back towards the tail, in consequence of the presence of two extended, brown organs above the heart, which proved to be the poison-glands. They are distinguished from those of other serpents by their length and by their situation just below the ribs in the ventral cavity. With their excretory ducts they occupy one-third or even more of the total length of the snake.

The true gland is entirely enveloped by a striated muscle, within which the smooth, white tendinous surface is concealed. It is formed of parallel tubes, among which the parenchyma of the gland occurs divided into little portions. In the middle the number of tubes is fifteen or more. They unite upon a large excretory duct in each gland. The excretory ducts run side by side to the head, where they are applied against the outer surfaces of the quadrate and maxillary bones; here a large salivary gland opens into each.

The author has detected the same glands in *Callophis bivirgatus*, Boié; but they do not exist in *C. calligaster*, which, however, does not belong to *Callophis*, or in the Elapid snakes of Australia (*Vermicella*, Gray), Africa (*Pœcilophis*, Gthr.), or America.—*Comptes Rendus*, April 12, 1869, tome lxviii. p. 860.

On the Geographical Distribution of the Ferns of Mexico. By Eugène Fournier.

The author has carefully examined the specimens of Ferns from Mexico in almost every collection existing in Europe, and arrives at the following results:—The number of species, which was given as 6 by Kunth, 182 by Martens and Galeotti, 312 by Liebmann (omitting synonymic forms), and 487 by Fée (of which 70 are to be suppressed), amounts, according to the author, to 605, besides a few others of which he has not seen specimens. Of this number, 47 are now indicated as Mexican for the first time; and 217 supposed species are suppressed as identical with others previously described.

The species of ferns are generally the same on both slopes of the Mexican Andes. Of the species enumerated by Smith as collected in the Sierra Madre on the Pacific slope, only three have not yet been discovered on the Atlantic side.

The author identifies a far greater number than his predecessors of Mexican species with species growing in other parts of America, especially between the tropics. Of his 605 species, only 178 are peculiar to Mexico; and these belong to groups largely represented in that country and wanting elsewhere in tropical America. Of the 427 species common to Mexico and other regions of America, 230 occur in the Andes of South America (New Granada, Ecuador, Peru, Bolivia), 139 in the Antilles (especially Cuba and Guadeloupe), 59 in Guiana or Caraccas, and 117 in Brazil, the greater part extending as far as Rio de Janeiro. The ferns of the high mountains of Mexico easily find a suitable climate in the Andes, even under the equator; 12 of them also pass beyond the intertropical region and descend into the province of Corrientes or to Montevideo, and 17 extend into Chili. Many of the latter, especially the *Pellææ*, pass into the mountains of Texas, whence 11 have been brought by Trecul.

The species of the neighbourhood of Orizaba and Jalapa growing at from 1000 to 1500 metres in the eastern Cordillera of Mexico, and some of which live in Florida or Carolina, also occur in part in Guiana, and most of them in Cuba and at Rio de Janeiro; some species even occur in Mexico and at Rio de Janeiro and are not at present known from any intermediate place.

The very few littoral species of ferns found in Mexico are generally diffused over the whole tropical region of the globe.

The most interesting group is one composed of only 12 species, which, starting from the bottom of the Mexican Gulf, and passing the Antilles, reaches the Azores and Canary Islands, then becomes diffused over the Mediterranean region and is continued by a small number of species in the mountains of Abyssinia and Persia and in the Himalaya. Of these, in passing northwards, *Pteris longifolia* stops in the island of Eschea, *P. cretacea* in Corsica, *Woodwardia radicans* in the mountains of Asturias, *Adiantum capillus* at Poitiers and at Bormio in the Tyrol near a hot spring, and *Gymnogramma leptophylla* at Brest, whilst *Cystopteris fragilis*, a polymorphic but indivisible species, spreads all over Europe and reaches the summits of the Alps. The authentically established existence of this group of plants agrees, in the author's opinion, with the hypothesis of

the disappearance of the Atlantis.—*Comptes Rendus*, May 3, 1869, pp. 1040–1042.

Note on the Structure of the Blastoidea.

By E. Billings, F.G.S., Palæontologist, Canada Geol. Survey.

The remains of the Blastoidea have as yet proved to be extremely rare in our Canadian rocks, only five small specimens (three of *Pentremites* and two of *Codaster*) having been collected up to the present time. While studying these with a view to their description, I was led to investigate the structure of the order, especially with regard to the function of the summit openings. On combining the observations of other authors, whose views I shall give in detail in another paper, I find that we have now sufficient data to establish the following points:—

1. In the genus *Nucleocrinus*, Conrad, there are sixteen apertures in the summit. Of these, the large lateral aperture is both mouth and vent. There is no opening in the centre of the apex, where the mouth has hitherto been supposed to have its position. The ten so-called "ovarial orifices" are respiratory apertures. Between each two of these, one of the ambulacral grooves enters to the interior through a small pore, which is a true ovarian orifice. There are thus ten spiracles, five ovarian orifices, and one buccal and anal orifice—in all sixteen.

2. In *Pentremites* there are also five ovarian pores, in the same position. The mouth is not in the centre, but in the larger of the five spiracles.

3. *Codaster* has no ambulacral pores in the so-called "pseudambulacral fields." The striated surfaces in the interradial areas are true Cystidean rhombs of the type of those of the genus *Pleurocystites*. These in *Pentremites*, *Granatocrinus*, and *Nucleocrinus* are situated under the ambulacra, where they constitute the tubular apparatus described by Roemer and others.—*Silliman's American Journal*, May 1869.

Tadpoles of Lissotriton punctatus *reproducing the Species.*

By M. J. Jullien.

On the 11th of April 1869, the author obtained four tadpoles of *Lissotriton punctatus*, which he dissected the next day, when he found in two of them not only fully developed ovaries, but in the oviducts eggs enveloped in the usual gelatinous layer. The other two were males. The only external differences between the two sexes were that in the females the labia of the cloaca were more developed than in the males, and that the body was shorter in the latter. The two females were as large as adults.

The testes, which were pretty well developed and fusiform, contained mother cells of spermatozoids, but no free spermatozoids. The ovaries formed two fine bunches, and the oviducts contained perfectly developed eggs in both females.

Subsequently the author obtained two more female tadpoles, which deposited several eggs in the course of a few days, without acquiring the adult characters.—*Comptes Rendus*, April 19, 1869, pp. 938, 939.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 20. AUGUST 1869.

VIII.—*On the Anatomy of* Diplommatina, *and its Affinity with* Cyclophorus *and* Pupina *in the* Cyclophoridæ. By JOHN DENIS MACDONALD, M.D., F.R.S., Staff-Surgeon, R.N.

[Plate IV.]

THE animal of the little Himalayan shell first named *Bulimus folliculus* in Dr. Pfeiffer's Monograph of the Helicidæ was discovered by Capt. Hutton and Mr. Benson to differ from that family in the situation of the eyes, these "not being borne on the summits of the tentacula." Capt. Hutton, in his MS., had actually named it *Carychium costatum*; but Mr. Benson, considering it to differ also from *Carychium* sufficiently to form the type of a new genus, named it *Diplommatina*. He chose this name from having observed that the eyes "were composed of two lobes—one lobe deeply seated in the tentaculum and larger than the other lobe, which is a small black point coming to the surface on the outer side of the larger lobe." "Had the animal been provided with an operculum," he further remarks, "it might possibly have been referred to the family of Cyclostomatidæ." It is clear, therefore, that Mr. Benson, while admitting the affinity of his *Diplommatina folliculus* to *Carychium*, considered it to be merely the type of a new genus at least referable to the same group, and not to the so-called Pulmonifera operculata. But the fallacy of reasoning upon insufficient data is well illustrated in the controversy which followed between Mr. Benson and Dr. Gray as to the character "operculo nullo" (Ann. & Mag. Nat. Hist. 1853, vols. xi. & xii.). There can be little doubt, also, but the belief on the part of the founder of the genus, that the eyes were situated on the posterior part of the tentacula near their base, gave colour to the possible absence of an operculum; and such would be more conformable with the section to which

it was too hastily assumed to belong. Dr. Gray, however, as it then appeared, settled the question satisfactorily by the examination of original specimens in which an operculum was undoubtedly present. At the time the number of the 'Annals' containing his letter came into my hands, I was employed in the South Seas*, and, being well acquainted with three distinct species of *Diplommatina* occurring at Lord-Howe Island, I thought I might readily furnish Dr. Gray with drawings of the shell, operculum, and animal of those species, should his argument require further support. Nevertheless, on visiting the island of Vatoa, Feejee group, I was not a little surprised to find a very minute and smooth pupiform shell, with dextral turns, thickened double peristome, and a tooth on the columellar lip, containing an animal in every particular identical with that of *Diplommatina* save the operculum, of which I did not discover a trace, though the cicatrix of the operculigerous lobe was distinct enough, as shown in the figures (1 & 2 *d*, Pl. IV). The above-mentioned question immediately recurred to my mind, and I also reflected how far are shell-characters to be trusted in the establishment of genera, and how wide is the latitude within which specific distinctions may range. I sympathized with Mr. Benson; for, according to my own experience, not only in this case but in numerous other Feejeean species, if the operculum be present at all, it must be in a very rudimentary state.

Conchologists might prepare a new genus for the reception of the little shell just noticed, which exhibits but few points in common with the known *Diplommatinæ*; yet even this would not shake my faith in a conclusion the truth of which is most evident to my own mind, namely, that the occupant is *Diplommatina*, name the dwelling what you please. In substantiation of this view, I may mention that of eight or nine new Feejeean species of the genus, all of which are sinistral, some have simple peristomes, others tooth-like processes in the aperture, and the latter is constricted, expanded, or more or less ascendent, as the case may be; but the animals are in all instances similar, or only exhibit specific differences. Although the generic characters of *Diplommatina* are now more comprehensive than they originally were, there appears to be a too great readiness on the part of pure conchologists to found new genera upon any shells that are not conformable in every minute particular with the primary description, which in the nature of things cannot be supposed to be infallible.

In the mountain-country of Na Viti Levu I found at least

* In H.M.S. 'Herald,' Captain, now Admiral, Sir H. M. Denham, K.C.B.

eight species of *Diplommatina*, and arranged them in my note-book as follows:—

I. Aperture in the plane of the axis of the shell.
  1. Peristome perfectly circular. Two species.
  2. Parietal lip meeting the palatal and columellar lips at an angle. Three species.

II. Aperture lateral.
  1. Peristome impinging on the penultimate whorl, edentate. One species.
  2. Peristome impinging on the terminal whorl; a tooth on the columellar lip.
    a. Shell full, large, sinistral. One species.
    b. Shell narrow, minute, dextral. One species.

At Norfolk Island I found a minute *Diplommatina* (Pl. IV. figs. 3 & 4) that would fall into the second division of the foregoing table, the aperture being lateral. The peristome is double, perfectly circular, and everted, the last two characters as well as its minute size being characteristic. The operculum (fig. 5) is quite circular, like the aperture, and regularly spiral, with a curved ridge for muscular attachment towards its anterior border.

In all the *Diplommatinæ* examined by me the eyes were uniformly situated at the outer side of the base of the tentacula, and even a little encroaching upon the head. I have always recognized, also, that their labial and lingual dental organs, like those of their near allies the *Pupinæ*, were strictly conformable to the Cyclophoroid and not to the Cyclostomatous type, which two natural families are still further distinguished by the *invariable presence of otoconia in the ear-sacs of the former, and single spherical otolithes in those of the latter.*

I am borne out in my statement as to the position of the eyes of *Diplommatina* by the remarks of Mr. W. T. Blanford accompanying an outline sketch of the animal of an Himalayan species by Capt. Godwin-Austen, published in the Ann. & Mag. of Nat. Hist. 1867, vol. xix. p. 306. He says, "I have more than once, within the last few years, called attention to the circumstance that, in the two supplements to Dr. Pfeiffer's admirable monograph of the living operculated land-shells, the position assigned to the genus *Diplommatina*, close to *Acicula*, and in a suborder distinguished by the position of the eyes above the base of the tentacles, is not in accordance with the structure of the animal;" and, referring to the figure, he further adds, "The eyes, as will be seen, are distinctly lateral, as in *Cyclophorus*." My own drawing (fig. 1), which was carefully taken from nature, confirms this view; and lest some

misunderstanding should arise as to the apparent situation of the eyes in fig. 2, it should be stated that the object was viewed by transmitted light—a circumstance that might account for the original mistake, had the animal been so observed. In regard to the supposed relationship of *Diplommatina* to *Acicula*, I can only say, not having been able to examine any of the typical *Aciculæ*, that, if they are indeed allies of *Truncatella*, they have nothing to do with *Diplommatina*.

The next important contribution to the anatomy of *Diplommatina* is to be found in a short paper by Mr. R. J. L. Guppy "On the Occurrence of *Diplommatina Huttoni* in Trinidad" (Ann. & Mag. Nat. Hist. 1867, vol. xx. p. 96), the more pertinent part of which runs thus:—"The lingual dentition, being very minute, is somewhat difficult of preparation; but I have been able to make out its characters, which are as follows:—The dental band is of moderate length; the teeth are 3 . 1 . 3, the median is broad, its edge narrowly reflexed and five-toothed, its base narrow, almost pointed. The first and second laterals are subclavate, their edges reflexed and three-toothed. The third lateral is somewhat hamate and obscurely tricuspid. The mandible is broad and flat, covered with very distinct, separate, lozenge-shaped plates. All this tends to induce one to retain this genus in the Cyclophoridæ, to which these characters attach it more closely than to the Cyclostomidæ." In these remarks we find a recognition of the distinctness of the two families named, and of what is unquestionably the true position of *Diplommatina*. The amber-tinted labial plates, composed of obliquely rhombic cells, first, I believe, noticed by myself in *Pupina* and *Diplommatina**, are quite characteristic of the Cyclophoridæ; for although very similar organs are present in *Natica* and *Triton* and their allies amongst marine Proboscidifera, the labial plates of *Cyclostoma*, *Hydrocena*, and *Assiminea* are very different. I have now only to remark that the dentition of *Pupina* is so identical with that of a species of *Cyclophorus* (fig. 10) occurring at the Isle of Pines, that I did not think it necessary to furnish a drawing of it. On the other hand, the dentition of *Diplommatina* makes a nearer approach to that of *Cyclophorus aquilum* figured by Mr. Woodward†, the central dental plates in particular being expanded in front to support a greater number of teeth. The recognition of the two types here indicated will be of importance in the distribution of other genera referable to the Cyclophoridæ.

* In a paper read before the Royal Society, Feb. 26, 1857, "On the Natural Affinities and Classification of Gasteropoda."

† Manual of Mollusca, p. 175.

EXPLANATION OF PLATE IV.

Fig. 1. An enlarged figure of a minute, smooth, pupiform shell, with an animal like that of *Diplommatina* protruding, obtained at the Island of Vatoa, Feejee; specimen young, not having yet attained the thickened double peristome noticed in the text.

Fig. 2. The animal removed from the shell, and exhibiting the following parts:—*a*, the labial or buccal plates, composed of thin indurated cells resting upon more or less regular courses of square ones; *b*, lingual cartilages and fore part of the tongue, with the lingual sac extending backwards from it; *c*, tapering tentacula, with the eye at the outer side of the base; *d*, the opercular scar distinctly visible (but the operculum was not found in this species); *e*, the auditory sac, containing otoconia; *f*, œsophagus; *g*, salivary glands; *h*, rectum.

Figs. 3 & 4, respectively, enlarged back and front views of a minute sinistral shell, with trumpet-like eversion of a perfectly circular, continuous, and double peristome; occurring at Norfolk Island.

Fig. 5. The operculum of the foregoing, highly magnified, as are also the following figures.

Fig. 6. Lingual cartilages, odontophore, and sac.

Fig. 7. Ear-sac, with otoconia.

Fig. 8. Buccal plates, the lingual teeth resembling the following.

Fig. 9. Two transverse rows of the lingual dentition of one of the *Diplommatinæ* of Lord-Howe Island.

Fig. 10. Ditto of *Cyclophorus*. Isle of Pines.

There is in nature even a closer resemblance between the external lateral teeth of these two tongues than is exhibited in the figures.

Haslar Hospital, June 5, 1869.

IX.—*The last Discoveries in the extreme North.* By Oswald Heer*.

The high northern latitudes contain a region larger than half Europe, and which, although less distant from us than most other parts of the world, is still entirely unknown to us. For a long time we have been trying to penetrate it. There, in fact, ought to be the shortest route from Europe to the East Indies and Western America. The search after this perfectly practical result, the discovery of a new maritime course, has, during the last three centuries, led to the greatest sacrifices; but, in spite of repeated efforts, the problem remains unsolved. To the present moment the 82nd parallel of north latitude marks the limits of an unexplored and always icy region, at the gates of which the bravest men have beaten in vain. We must even add that we have lost all hope of one day discovering a maritime route leading to the Indies across the polar seas.

* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle,' tome xxxix., April 1869, pp. 512–543.

But exploring-voyages in these unknown regions have not lost their attraction on this account. With these expeditions it is as with the ascent of our mountains. At first we are impelled by a scientific interest. We wish to study nature even on the most elevated crests of the Alps. Then there is an irresistible attraction in perilous enterprises which leads man to the frightful solitudes of the high mountains. When he has succeeded in reaching a spot never before trodden by human foot, and his eyes glance over the marvellous scenes which surround him, he esteems himself fully recompensed for all his trouble and for all the risks which he has run.

It is true that no lofty summit attracts exploration towards the polar regions. But (and the chief of the polar expedition of last year has written to me to this effect within the last few days) the naked rocks and the dazzling ice-fields of the high northern regions, desert and frozen as they may be, possess a marvellously captivating charm for any one, whether a philosopher or an untutored sailor, who has once trodden them. To reach the pole, or at least a latitude to which man has never yet penetrated, seems to them an object as worthy of their efforts as to the tourist the ascent of a virgin peak. In themselves both these results are of equally little importance. But if scientific researches are combined with these polar expeditions, and if they extend the field of our knowledge, they are entitled to the interest of the public.

It is this that encourages me to make known briefly the results of two voyages in the glacial zone, undertaken during the last two years,—namely, that of Mr. Whymper in North Greenland in the summer of 1867, and that of the Swedish expedition to the north pole in the course of last summer.

I. Mr. Whymper's Expedition.

The results obtained by the study of the fossil flora of the high northern latitudes had attracted the attention of the Royal Society of London and the British Association. Upon the proposition of Mr. R. H. Scott, Director of the Meteorological Observatory of London, they voted a considerable sum, with the object of collecting in North Greenland new fossil remains, which would allow the investigations already commenced to be pursued further. This mission was confided to Mr. Edward Whymper, well known among us for the first ascent of Mont Cervin. He took with him Mr. Robert Brown, who had just returned from a voyage to Vancouver's Island.

Every spring a ship sails from Copenhagen to the north of Greenland. In this vessel the travellers made the passage, in

May 1867. In the first week of June (June 6), they landed at Egidesminde, a Danish establishment of desolate aspect. Vegetation is almost entirely wanting on this little island. The granite rocks were still covered with snow, and the ponds with a layer of ice. The dwarfish herbage, which was just beginning to grow, announced the first awakening of spring. Thence the travellers went in a boat to Jakobshaven (in 69° 10′ N. lat.), which they selected as their headquarters, and from which they would endeavour to penetrate into the interior of the country.

Off the mainland along the western coast of Greenland there are innumerable islands and peninsulas, cut out by fiords which deeply indent the shore. These advanced lands are the only parts inhabited and known at present. Starting from them the ground rises, most frequently in scarped slopes or in abrupt walls of rock, to a height of 2000 and 3000 feet, and forms a plateau covered by an immeasurable sea of ice—no doubt the largest that exists in the world. How were these glaciers to be traversed and explored? Mr. Whymper hoped to succeed by means of sledges drawn by dogs. Much time was required to procure these animals and the provisions necessary for their nourishment; for scarcely anything was to be found in the little settlements of the Esquimaux. When the expedition was ready to start, the Esquimaux who ought to have accompanied it had disappeared; they had gone to a neighbouring colony to take part in a dance. Consequently it was the middle of July before they could start. The travellers passed in boats through the long fjord of Illartlek, filled with mountains of ice detached from the two glaciers which abut upon it. They then ascended to the plateau, which at this point rises to about 2000 feet above the sea. Thence, as far as the eye could reach, they discovered nothing but a vast extent of ice, without elevations, without any depressions, without valleys—a continuous sheet filling up and covering equally the ridges and valleys, and thus forming an icy plateau, which loses itself in the interior in an unlimited distance, emitting on the shore side very numerous arms which descend even into the sea. These branches follow the primitive valleys, and incessantly convey new mountains of ice to the ocean. As no naked rocks are to be seen anywhere projecting above the glacier, the latter has no moraines; but it is furrowed with crevasses and fissures innumerable, and from place to place it was cut by large lakes. Mr. Whymper soon convinced himself by experience of the impossibility of penetrating into the interior by advancing upon this ice. The sledges could not advance; they were continually being upset upon this rugged and crevassed

surface: one of the vehicles was soon broken, and the dogs would not be guided. Under such circumstances the explorers were obliged to give up their enterprise. They had, however, seen enough to understand that there was no hope there of attaining in some degree the essential object of their voyage, which was to collect fossil plants.

Mr. Whymper therefore returned to the coast with his companions, and proceeded to the great peninsula of Noursoak, in the neighbourhood of which the vessel had some trouble in finding a way through the labyrinth of icebergs which filled these waters. They proceeded from the glacier of Tossukatek, the jagged crest of which bounded the horizon. Upon the peninsula of Noursoak Mr. Whymper met with a Dane who had lived alone among the Esquimaux for twenty-four years. The peninsula forms an elevated plateau traversed by a range of mountains which attain a height of 6000 feet. Upon one of these mountains, situated near Atanekerdluk, is the principal deposit of the fossil plants of Greenland. Of this I have already spoken, two years ago, in the pages of this Review*. The remains are contained in a reddish-brown rock, composed essentially of iron: this is literally filled with them; branches and leaves, fruits and seeds, are collected in it pell-mell. Pieces of amber are scattered among the branches which probably produced them.

They first of all set to work upon this deposit, which is situated in 70° N. lat., and at about 1100 feet above the sea. For three days Mr. Whymper, Mr. Brown, the interpreter Tegner, and eleven Esquimaux were at work releasing these plants from their iron prison and bringing them to the light of day. A considerable quantity (about 10 quintals) of them was carried down to the shore.

When this digging was completed, Mr. Whymper and his companions traversed the Waigat to reach the Island of Disco. This is equally mountainous; and the coast rises from the sea in scarped walls of rock with wild rents and fissures. The only inhabited place in the island is Onnartuvarsok, opposite Atanekerdluk. Here also deposits of lignite are found; they extend along the eastern side of Disco, and are covered by a layer of sandstone, above which there are thick beds of basalt. The coal contains amber; and here and there in the sandstone there are fossil plants—for example, near Ujararsusuk and Kûdliset. Here were discovered magnificent leaves of *Platanus*, large fruits of *Magnolia*, and branches and cones of a *Sequoia* (*S. Couttsiæ*). Towards the north of Kûdliset a narrow

* "Les Régions polaires du Nord" (Bibl. Univ. January 1867, p. 51).

gorge opens, bounded by walls with extremely wild ravines, at the bottom of which were accumulated large masses of hardened snow; at the end a nearly vertical wall of basalt, crowned by a glacier, rises to a height of about 2000 feet.

Mr. Whymper traversed the Waigat at this point in order to visit the south-west side of the peninsula of Noursoak, along which he regained Atanekerdluk. The treasures previously collected had been increased by interesting objects of antiquity; for Mr. Whymper having caused diggings to be made in the localities of ruined Esquimaux huts which had long been abandoned, had found there weapons and utensils of flint and bone, which appear to have a great analogy to those of our lake-habitations. The little vessel could hardly contain all these riches. After a tiresome and dangerous passage, the explorers arrived first at Ritenbenk and afterwards at Godhaven, the residence of the Inspector of North Greenland. There they embarked on the 10th of September for Europe, and arrived in Copenhagen on the 22nd of October.

It is to be regretted that Mr. Whymper lost precious time in his attempts to penetrate into the interior of the country by the glaciers; for he thus rendered it impossible for him to visit the north side of Noursoak, where there lies buried a very interesting Cretaceous flora, which I had particularly recommended him to work at. Nevertheless the collection which he brought back to London, and which was afterwards sent to me for examination, is of considerable scientific value. Exhibited at present in the British Museum, it has notably added to our knowledge of the ancient flora of Greenland; so that the imagination may now clearly picture the aspect of these northern countries during the Miocene period. I will beg leave to indicate rapidly a few of its features.

At the period when the sandstones which compose the smiling hills of the environs of Zurich were deposited, a considerable extent of *terra firma* must have existed in the extreme north. To this period the name of *Miocene* has been given, or more generally that of the *Tertiary period.* Our countries then had almost a tropical climate. Among the forests of laurels and the tufts of palm trees lived numerous animals belonging to types which now-a-days occur only in the warm and, even, torrid zones. Towards the north, indeed, the ground was clothed in a different vesture; nevertheless Greenland, even at 70° N. lat., presents a flora which, by its climatic characters, may be compared with that of northern Italy. This flora teaches us that in the region where the Island of Disco and Atenekerdluk are situated, there was a lake of fresh water, upon the marshy edges of which great beds of peat were

formed. These subsequently gave origin to the deposits of coal which appear along the coast. In our marshes it is not rare to see ferruginous water, which covers the soil with a reddish-brown crust. The same thing took place in the ancient marshes of Greenland: the iron deposited itself upon the plants which fell into the water; and these, in their turn, contributed to the precipitation and fixation of the iron. By this means has been gradually formed that ferruginous rock in the bosom of which numerous plants are imprisoned. These fossils show that the marshes were covered with sedges and reeds; but the marsh-cypresses, the water-pines, the birch, the alder, and the poplar likewise flourished there; for numerous fragments of these plants are covered by a ferruginous deposit. The water-trefoil (*Menyanthes arctica*), no doubt, grew in the marshes, in the same way that the existing species adorns our moist meadows with its charming flowers; and the burr-reed (*Sparganium*), the fruit of which has been obtained from these rocks, also formerly raised its bristling heads above the waves. The rivulets also brought in leaves from other localities; they conveyed them from the primitive forests; and it is thus that we find their traces in the impressions of the ferruginous rock.

If we enter into these forests, we shall find in them a marvellous profusion of trees and shrubs, among which we can distinguish ninety-five different species. A tree with acicular leaves (*Sequoia Langsdorfii*) strikes us at once by its enormous proportions; in its aspect it may be compared with our yew, but it belongs to the category of giant trees. It has left leafy branches in such numbers that there is scarcely a fragment of stone which does not contain its remains; and the flowers, fruits, and seeds which the hammer has extricated from the rock enable us to reconstruct the entire tree. It is accompanied by two allied species, one of which (*Sequoia Couttsiæ*), by the configuration of its branches and leaves, vividly reminds us of the gigantic *Sequoia* of California. A *Thuia* had a different aspect, as also the Ginko (*Salisburia adiantoides*), of which the leaves, resembling the fronds of ferns, differ so greatly from those of other Coniferæ. The leafy trees are especially well represented. Whilst our existing forests only present two species of oaks, Northern Greenland possessed nine, four of which must have been evergreen trees, like the Italian oak. Two beeches, a chestnut, two planes, and a walnut from this forest resemble the types of the same names known to everybody. Besides these, American species, such as the magnolias, sassafrasses, and liquidambars, were represented there; and the characters of the ebony trees (*Diospyros*) are to be distinguished in two of the species.

The hazel and the sumach, the buckthorn and the holly, the guelder-rose and the whitethorn (*Cratægus*) probably formed the thickets at the borders of the woods; whilst the vine, the ivy, and the sarsaparilla climbed over the trees of the virgin forest, and adorned them with green garlands. In the shadow of the woods grew a profusion of ferns, which covered the soil with their elegant fronds.

The insects which gave animation to these solitudes are not all lost. The impressions of these which have reached us show that little Chrysomelas and Cistelidæ enjoyed themselves in the sun, and large Trogositæ pierced the bark of the trees, whilst charming Cicadellæ leaped about among the herbage.

This picture is not a dream of the imagination. Plants and animals, all have passed under my eyes. Of several species of trees only the leaves had previously been brought from Greenland, and it was from these that we classified them; now the fruits also have been found, which have confirmed our determinations. Thus two fruits of *Magnolia* have been discovered, as also the fruits and flowers of the chestnut-tree. The chestnuts, as in the species now living, are surrounded by a spinous envelope, in the midst of which there are three fruits. In all, we have received from this part of Greenland 137 species of plants, 32 of which were discovered by Mr. Whymper.

We still know this ancient flora only from the remains collected upon a few points of northern Greenland; for hitherto a narrow band of this country along the sea-coast has alone been explored. The German expedition of last summer ought to have thrown a new light upon the eastern coast. It might, in fact, have solved a very interesting question, if, landing at 70° N. lat., it had set to work at the investigation of the rich deposits of fossil plants and animals discovered by Scoresby, the specimens from which were lost before being submitted to scientific examination. The expedition reached land at 73° N. lat.; but great masses of ice rendered the coast unapproachable at this point, and the navigators only saw Greenland from a distance. To make up for this, they made their way by Hinlop's Strait to Spitzbergen, exploring that country and advancing to 81° 5′ of north latitude. The scientific results of this expedition have not yet been published*; but accounts of the voyage have appeared in so many journals and periodical publications, that I may suppose them to be known. I pass therefore without further delay to the polar expedition which the Swedes attempted last summer.

* According to a communication which I have received from Dr. Petermann, no fossil plants were found.

II. Swedish Expedition.

There is perhaps no country in Europe in which natural history has been studied with so much care as Sweden. The naturalists of that country have extended their investigations far beyond their own territories, and within the last few years in particular they have pushed them as far as Spitzbergen, which, with Greenland, constitutes the most northern land that we know. It is this that gives it a special interest. The expedition organized in 1868 is the fourth within eleven years that has started from Sweden for Spitzbergen with a scientific object*. Prof. Nordenskiöld, of Stockholm, has taken part in all these expeditions; and it was he that was intrusted with the conduct of the last, concurrently with Capt. d'Otters. The Government placed at the disposal of the explorers an iron ship, with its equipment and provisions; the Academy furnished them with scientific instruments; and, in consequence of an appeal from the Count d'Ehrensværd, the necessary funds were promptly subscribed at Gothenburg by private individuals. Nor was there any deficiency of intellectual resources; for eight naturalists had offered their assistance—

* The first expedition was organized in 1857 by Prof. Otto Torell and at his own expense. Accompanied by MM. Nordenskiöld and Queenerstedt, M. Torell, in the course of two months and a half, traversed and studied the whole western coast of Spitzbergen. M. Torell had already visited Iceland for the purpose of studying its glaciers. In 1859 he pursued his researches upon glaciers in Greenland, whence he brought back rich collections, among which were some fossil plants, which I had the opportunity of examining. The Swedish Government and Chamber of Representatives highly appreciated the noble zeal of M. Torell, and granted a considerable sum (52,000 francs) for a new expedition, the object of which was to examine the natural history of Spitzbergen and the sea surrounding it from all points of view. The travellers were also to endeavour to reach the fixed polar ice, in order to make their way thence towards the pole by means of sledges drawn by dogs. In this way, in 1861, a second and very important expedition was organized, which, besides the subsidies from the state, received other assistance from Prince Oscar, from the Academy of Sciences, and from several private individuals. It was placed under the direction of M. Torell. Notwithstanding many unforeseen obstacles (the ship having been long imprisoned by the ice in the Bay of Treurenberg), Spitzbergen was carefully explored, and considerable collections in all departments of natural history were brought back from it. The voyage towards the pole could not be undertaken, on account of the bad state of the ice. The third expedition went to Spitzbergen in 1864, under the conduct of M. Nordenskiöld. Its principal object was to ascertain whether it was possible to measure a degree of the meridian there; with this object the astronomer Duner accompanied it. But it likewise added considerably to our knowledge of the geology of this archipelago. All these important expeditions were undertaken by the Swedes in consequence of the impulse given, in 1837, by Prof. Lovén, of Stockholm, who went to Spitzbergen in a vessel bound on the walrus-fishery.

three of them, MM. Nordenskiöld, Malmgren, and Fries, being already well known by excellent works upon Spitzbergen. The principal object of the expedition was, again, the natural history of Spitzbergen: the travellers would then endeavour to advance towards the pole, but in the autumn, in the hope that that season would be more favourable than the summer for such an enterprise.

On the 19th of July the expedition quitted Tromsœ, in the north of Norway.

The navigators first stopped at Bear Island, which they reached in two days. The island, which is of small extent and still but little known, contains grey mountains of a sombre aspect. In the interior it has the form of a plateau cut up by numerous little lakes and sprinkled over with innumerable fragments of rock. Its vegetation is extremely meagre, for nowhere can the herbage form a turf. And yet this sad and poor islet has had its Robinson Crusoe. A Norwegian named Tobiesen made a hermitage for himself upon it, and lived for a long time in this solitude. Marine animals and, in summer, birds furnished him with his food. The Swedish expedition employed five days in exploring the island in all directions. In certain places an innumerable quantity of birds darkened the air; and the projecting rocks on the mountains bordering the shore were covered with them to such an extent that they might have been supposed to be enveloped in a mantle of snow. Gulls and other aquatic birds, especially ducks, predominate; in the summer they go northwards in immense troops, breed upon the steep shores of these parts, and then, when the autumn arrives, depart again towards the south. This phenomenon, which constitutes one of the peculiar characters of the polar zone, is everywhere observed.

This abundance of animal life forms a strange contrast with the poverty of the vegetation. Formerly, no doubt, this was not the case. A very important discovery made in the course of this expedition has given us some information upon this point. It has long been known that carbonaceous deposits exist in Bear Island; but their geological age was unknown. Now MM. Nordenskiöld and Malmgren have found, in the carboniferous beds and the rocks which contain them, numerous fossil plants which give us the most precise information upon this point, as will be seen hereafter. They detached from the rocks several hundred specimens of fossil plants, and shipped them on board their vessel with the other natural-history treasures which they had collected.

The expedition at last set out for the south of Spitzbergen. On their arrival there the travellers proposed to go towards

the east, in order to endeavour to find Gillisland, and then to sail towards the north along the eastern coast of Spitzbergen. But when they arrived at Stor fiord, and wished to advance towards the Thousand Islands, colossal mountains of ice came to meet the ship. These glaciers presented a magnificent spectacle in the blue water of the sea. The navigators, not allowing themselves to be stopped by these floating masses, attempted to penetrate their labyrinth. Soon, however, they found them accumulated in such quantities and so close to each other, that it was necessary to give up all idea of pressing forward. They therefore went back to gain the western coast of Spitzbergen, to the investigation of which they devoted several weeks.

The extent of Spitzbergen is about equal to twice that of Switzerland. On the west coast several long fiords penetrate deeply into the interior, and push their way like great lakes between the high mountains which rise everywhere from the sea-shore. Into all these fiords great glaciers descend, from which enormous fragments are constantly detaching themselves, passing towards the sea, and forming floating mountains. King's Bay in particular has a savage grandeur which is calculated to inspire terror; it is completely framed in by glaciers, which descend in scarped slopes towards the sea, and present innumerable fissures.

The northern shore of the Ice fiord is covered with similar glaciers, whilst on the southern shore there are here and there sheltered spots where small colonies of alpine plants with brilliant flowers enamel a carpet of moss. There are found rosy beds of *Silene acaulis* and the blue *Polemonium*; the violet saxifrage (*Saxifraga oppositifolia*) adorns the rocks, and among the stones grow the white *Dryas octopetala* and the arctic poppy; on some points a greensward even ventures to show itself. The Ice fiord is therefore the chosen residence of the reindeer; and for years they have been sought there. Last summer two parties of English sportsmen went there to hunt the reindeer. A more abundant produce, however, is furnished by the marine animals. In the Ice fiord numerous white dolphins play about; and these within the last few years have become the object of a productive fishery: six vessels were engaged in it when the explorers arrived on these shores. But this movement is but the shadow of that which was to be observed a hundred years ago. Every year from 200 to 300 vessels arrived in these waters, and 12000 sailors were engaged there in the lucrative whale-fishery. On Amsterdam Island, in Schmeren's Bay, a regular town of wooden barracks was raised in the summer; it was established for melting the

fat of the whales, and to render the life of the crews more comfortable. Now-a-days, indeed, the whale has almost disappeared from these seas, and it is necessary to go in search of it to Behring's Straits or to the south polar seas. Nevertheless the coast is always tolerably animated in the summer, and in July and August must furnish a residence as agreeable as the high valleys of our Alps. Our naturalists found the place so much to their liking, that they assert the time is not far distant when hotels will be built in Spitzbergen for the summer season, and invalids will be sent to that island as they are now sent to the alpine valleys.

The natural history of this great fiord was investigated from all points of view. While the physicist of the expedition, M. Lernström, carried on the preparations commenced for the determination of a degree of the meridian, and set on foot meteorological observations, the zoologists and botanists (MM. Malmgren, F. A. Smitt, T. M. Fries, Berggren, Holmgren, and Nyström) busied themselves with collecting the plants and animals of the land. They sounded the bottom of the ocean at a great many points, and brought up from depths varying between 3000 and 15000 feet a great number of very small but very curious forms of animals. The geologists (MM. Nordenskiöld and Nauckoff) were not the least active: they set to work particularly to discover and collect fossils; and they were assisted in their work by M. Malmgren. In this last-mentioned department it was the mountains of the Ice fiord and of King's Bay that furnished the richest harvest. At Cape Starastschin, the western point of the Ice fiord, they discovered, in a black schist, a very curious flora, and at the head of the gulf large bones of extinct animals resembling the crocodile.

Leaving most of the naturalists settled upon *terra firma*, M. Nordenskiöld and the captain sailed westward in the ship, to seek for Greenland. They reached the boundary of the ice under the meridian of Greenwich, and at 80° 20′ N. lat.; but being soon convinced that the edge of the ice inclined rapidly towards the south, they turned eastward, trying to advance as far as possible towards the north. They arrived at 81° 10′ N. lat.; but there the narrow channel into which they had ventured came to an end. Northwards, as far as the eye could see, there was nothing but boundless ice. On the 30th of August the vessel returned to King's Bay. It afterwards made an excursion towards the Seven Islands, at the north of Spitzbergen; they were found to be completely surrounded by ice, and it was impossible to advance further towards the east. The explorers then turned towards Hinlop's Strait and the

eastern coast of Spitzbergen, where the German expedition had resided for a considerable time. All that they saw towards the east was a dark line rising above the horizon, indicating a land which no man has ever yet trodden, and of which we know neither the extent nor the form.

On the 13th of September the travellers returned to Amsterdam Island. They had been preceded there by a coaling vessel coming from Norway, and in which the scientific commission returned home, except Prof. Nordenskiöld and Dr. Berggren. The moment had arrived for them to make their great attempt, and to advance towards the pole by surmounting the barrier of ice which separated them from it.

They steered at first towards the Seven Islands, then further to the north, taking advantage of all the navigable passages. On the 18th of September they reached the latitude of 81° 30′, and on the following day, in 17° E. long., the latitude of 81° 42′, the highest that any vessel has ever reached in the north. A photograph of this spot, which has been communicated to me by M. Nordenskiöld, shows that the ice was cut by a narrow sinuous channel, into which the vessel had got; towards the north this passage was lost, and the ice formed a boundless plain. Of course it was out of the question to penetrate any further. Whilst one part of the crew set on foot some observations upon a great table of floating ice, the Swedish standard was hoisted with the firing of a gun, in order to celebrate the arrival of the expedition at the most northern point of our earth which a ship has ever attained.

The vessel had now to turn back towards the south. After several vain attempts to penetrate into the ice at other points, it reentered Schmeren's Bay on the 26th of September.

On the 1st of October it again took its course towards the north; but at 80° 14′ N. lat. it met with thick ice. The conditions had become considerably altered. The sun only showed itself for a very short time, for the nights had become rapidly lengthened. Even in summer, snow-storms had sometimes succeeded warm and serene days without any transition; these had become more and more frequent. The snow converted the water into a thick paste, which the storms drove before them and turned into innumerable icicles, which were frozen together during the night by a cold of 15° (C.). On the 4th of October, in 81° N. lat., the vessel was quite surrounded by ice. At 3 o'clock in the morning, its head was turned to the south, in order to break the ice and escape from its prison. During this time there arose a violent storm, which tossed the ship about in the midst of a multitude of fragments of ice. At half-past 6 A.M. the cry of "a leak!"

was heard. In fact the side of the vessel had struck so violently against a block of ice, that a plate of iron had been torn and a leak opened into the coal-hold, by which the water penetrated. This compartment was immediately closed, and all the openings were caulked, in order to prevent the water from penetrating further. But within an hour it had already got between decks, and entered the engine-room. There was much cause to fear that it would extinguish the fire, and then all would have been over. We may easily imagine with what energy all on board worked at the pumps, to escape the death that menaced them. For eleven consecutive hours they never interrupted their work, even to take a little nourishment. There were 6 degrees of cold, and the storm was continually driving over the deck icy water, which drenched the workers. Notwithstanding all their efforts, the water continued to rise, and the danger became more and more pressing. At last the shore of refuge was seen. The captain steered for the nearest land, and at 6 o'clock in the evening reached Amsterdam Island. After many hours of hard labour and fatigue, they succeeded in getting the vessel on its side and in closing the leak, and then pumped out the water that still remained in the hold.

All further attempts to penetrate towards the north were now given up. It was even out of the question to execute the original plan, and to pass the winter at the Seven Islands, in order to start in sledges towards the pole on the return of spring. The expedition had no dogs, and for such a journey they are indispensable. After trying once more to reach Gillis's land by starting from the south of Spitzbergen, the 'Sophie' returned to Tromsœ on the 20th of October.

The Swedish expedition has demonstrated that during the autumn of last year, north of Spitzbergen nearly as far as the 82nd degree of latitude, the sea presented free ice, but that, even at that season of the year, it was impossible to approach nearer to the pole. This observation relates to a point situated nearly in the same meridian as that in which the German expedition attained the latitude of 81° 5′, and nearly the same also under which Scoresby and Parry advanced, years ago, to 81° and 81° 30′ of latitude. In none of the attempts made to penetrate northwards by starting from Behring's Straits have the parties got so far as by starting from Spitzbergen: the reason of this is that in the former seas continuous ice is met with at a much earlier season. It is therefore very improbable that the pole can be reached in a vessel, even in the most favourable years; and when M. Lambert, who is now orga-

nizing an expedition to the pole for the present year, indicates beforehand the period when the French flag shall float at the north pole, we can see nothing in such an announcement but pure humbug. On the other hand, it is likely enough that men will succeed in reaching the pole by employing sledges to perform the journey, as has already been attempted by Parry from the north of Spitzbergen, and by Kane and Dr. Hayes from Smith's Strait.

But a matter very different in importance from this is the scientific investigation of the ocean and land in the polar zone. In my opinion, the Swedish expedition, by the rich collections which it has brought together, has obtained much greater results, and has contributed far more to the extension of the horizon of our knowledge, than if it had brought back the news that the 'Sophie' had hoisted her flag upon the very point that we call the north pole.

These collections have not yet, properly speaking, formed the subject of any work; but what I have seen of them leaves me no doubt that the Swedish expedition of last year will take its place worthily by the side of those which preceded it, and will even surpass them with respect to the important scientific data which it will furnish. Although organized without much fuss, it evidences considerable activity, great skill, and high scientific intelligence. It will thus renew in a brilliant manner the old reputation for knowledge which the Swedes have acquired in the study of natural history. Allow me to prove this by indicating some of the results which we owe to it. These belong, it is true, only to one of the directions of this activity—the zeal with which they have collected fossil plants. Of these M. Nordenskiöld has sent me more than 2000 specimens, which I only received a few weeks ago. To obtain a perfect knowledge of such numerous materials, a much longer time must be devoted to them; nevertheless I may mention a few facts which show in what manner the great revolutions which have passed over our planet have been manifested in Spitzbergen.

As early as the Carboniferous period, dry land existed at the spot now occupied by Bear Island. The plants collected by MM. Nordenskiöld and Malmgren belong to the lower and therefore the most ancient beds of that formation. The plants occur either in the coal itself or in the rocks which contain it.

The principal types are Calamites, *Sigillariæ*, and *Lepidodendra*, accompanied by several ferns. These plants belong for the most part to the same species as those contained in the most ancient formation of the mountains of the Carboniferous period in Europe; they are such as have been indicated in

Germany and in the Vosges. I will notice particularly *Calamites radiatus*, Brongn., *Lepidodendron Veltheimianum*, *Sigillaria distans*, and *Stigmaria ficoides*; these are trees which possess no flowers; but, as if to replace these, the bark of these plants is adorned in various ways: the Calamites have regular, parallel longitudinal ribs; the *Sigillariæ* have elegant cicatrices arranged in lines, and the *Lepidodendra* regular shields which cover the whole of the stem. Even the roots of the *Sigillariæ*, which have been named *Stigmariæ*, present this adornment, seeing that the points of attachment of the radicles are indicated by annular prominences.

None of the plants now in existence can give us an exact idea of the forest which formerly covered Bear Island. Those of our plants which most resemble the Calamites are the Horsetails; the *Lycopodia* are the analogues of the *Lepidodendra*: but we must by imagination raise the Horsetails and *Lycopodia* to the size of trees. With their columnar trunks and their long needle-like leaves collected in tufts at the extremities of their branches, the *Sigillariæ* must have presented a very strange appearance. Some species (*Sigillaria Malmgreni*, *S. Canneggiana*, and *Lepidodendron Wilkii*, Heer) are peculiar to Bear Island; at least they have never yet been found elsewhere.

But, even within the Carboniferous period, this land sank down again. The beds of coal and the rocks in immediate contact with them are covered by calcareous deposits, which contain numerous marine animals belonging to the same epoch. The Swedish naturalists found an identical limestone with the same marine fossils in the Bell Sound at Spitzbergen. This subsidence probably extended to the whole of the polar zone; for a perfectly similar phenomenon is presented upon Melville Island. There also a coal is met with in which I discovered the *Lepidodendron* (*L. Veltheimianum*) which we have also made acquaintance with in Bear Island; and above this Carboniferous formation the Mountain-limestone also occurs.

The animals that have been found in this limestone, both in Melville and Bear Islands and at Spitzbergen, lead to the same conclusions as the plants. They are for the most part species identical with those which we find in Europe in the mountains of the Carboniferous epoch; and some of them have occurred in this formation even in India and the south of America.

Upon the Mountain-limestone at the head of the Ice fiord rests a black schist, in which M. Nordenskiöld discovered a marine fauna belonging to a subsequent period, namely, to

what has been named the Triassic or Saliferous formation. This consists of numerous shells, and in part also of species which lived in the seas by which our countries were covered (such as *Halobia Lommelii*), and also of large animals resembling crocodiles and known as *Ichthyosauri*.

Spitzbergen has likewise preserved a certain number of species of animals belonging to the following or Jurassic period: these also are known forms, ammonites and cuttlefishes, such as are so frequently met with in the Jura.

The Cretaceous formation has not yet been indicated; but great deposits have been met with belonging to the following epoch, the Tertiary formation, and in this to the Miocene period, which has left so rich a flora in Greenland.

We find in Spitzbergen the same vestiges of the past as in Greenland. Spitzbergen also must have possessed a freshwater lake surrounded by peaty marshes; for at the Bell Sound in the Ice fiord we see extensive deposits of lignites, originating from turbaries, and which are now surrounded by sandstones and by a fine argillaceous schist containing plants belonging to that period. In the lake grew a *Nenuphar* and a *Potamogeton* (*P. Nordenskiœldi*) perfectly resembling that so often met with in the Swiss lakes (*P. natans*). This species occurs at Bell Sound and in the Ice fiord: from this we may conclude with some certainty that the lake extended over the whole country. In the waters of the lake little insects (Coleoptera) played about; their remains have been preserved in the schists of Cape Starastschin. On the bank grew a large reed and the same marsh-cypress (*Taxodium distichum miocænum*) that we have made acquaintance with in Greenland. Numerous branches of this have been sent to me, obtained from Bell Sound and from Cape Starastschin; to my great delight I found among these remains fruits, seeds, and even branches bearing the elegant flowers of this tree. These remains show that the deposits were formed in the spring as well as in the autumn. The characters of this marsh-cypress agree with those of the species now living in the United States, where it overshadows great marshes. It indicates this remarkable fact,—that even at a very ancient epoch it presented the same form as in the present day, but that then it attained the 78th degree of latitude, whilst now it does not pass the 40th degree; even by cultivation and under favourable circumstances, it cannot be obtained beyond 57° N. lat.

Besides this marsh-cypress, I have also received from Spitzbergen twenty species of Conifers, amongst which are the branches and fruits of a new *Sequoia* (*S. Nordenskiœldi*),

three Thuias, two from the Ice fiord and another (*Thuites Ehrenswärdi*, Heer) from King's Bay (in 79° N. lat.), and, lastly, ten species of pines and firs. It is to be observed that of these last we do not find any branches, but only isolated needles and seeds. The latter are furnished with wings, so that the wind would carry them easily. The trees therefore grew at some distance from the lake, forming a forest which covered the hills, from which a few seeds reached the lake.

Although Conifers predominated at Spitzbergen, leafy trees were by no means wanting. Two species of poplars (*Populus arctica* and *P. Richardsoni*) present characters which agree with those of the species found in Greenland; they were very widely spread, and may be traced from Bell Sound to King's Bay. They probably grew in the marshes or on the banks of the rivers with the birches, alders, and *Nyssæ* (*N. Eckmanni*), whilst a plane tree with large leaves, a lime tree, and two species of oaks, the leaves of which alone have reached us, no doubt composed the forests of the drier soils. Over these trees climbed the same ivy (*Hedera M'Clurii*, Heer) which we have indicated in Greenland and on the Mackenzie; among the shrubs, besides those which have already been mentioned, we find a hazel (*Corylus M'Quarrii*) which is spread over the whole arctic zone, a dogwood, and a buckthorn.

We know in all, up to the present time, forty species of trees and shrubs from Spitzbergen, coming from a zone comprised between 78° and 79° of north latitude. To these must be added numerous herbaceous plants—Gramineæ, Cyperaceæ, Najadeæ, Polygoneæ, Alismaceæ, Nymphæaceæ, Ferns (*Adiantites Dicksoni*, *Siphonopteris Blomstrandi*, Heer), and horsetails (*Equisetum arcticum*). Thus we find on the shores of the lake of Spitzbergen the remains of a varied vegetation which differs completely from that which, in our days, endeavours to clothe with a scanty mantle the few patches of ground left uncovered by the ice. Formerly, therefore, a luxuriant vegetation of leafy trees and conifers adorned this country, which is now covered by unlimited glaciers; and this is certainly one of the most remarkable facts, for the knowledge of which we are indebted to the Swedish expedition.

Insects were not wanting in this forest: I already know ten species the characters of which are perfectly in accordance with the flora.

The largest and commonest trees of Spitzbergen also flourished in Greenland. This fact renders it very probable that Spitzbergen was formerly united to Greenland. As the flora of the latter country is only known by discoveries made upon the western coast, we can hardly doubt that these common

species, such as the marsh-cypress, the poplars, the hazel, and the oaks (*Quercus platania* and *Q. grœnlandica*, Heer), were also spread over the isthmus which united the two lands, and that the whole of Greenland had the same vegetation.

This forest vegetation disappeared during the following or Pliocene period, and during the glacial epoch, when our countries themselves had a climate which in many respects resembled that of high northern latitudes. The Swedish expeditions have collected important observations upon the manner in which this remarkable change was brought about in the arctic regions; but the space at my disposal will not allow me to enter into details on this subject. I may, however, be permitted to mention briefly some facts which stand forth more clearly than ever from the information brought back by Mr. Whymper and by the last Swedish expedition.

In the first place, it becomes evident that our knowledge of extinct plants and animals has ceased to be so incomplete and to present so many gaps as the partisans of the doctrine of the mutability of species are pleased to assert—an assertion, however, which is very necessary to their hypothesis. The animals and plants obtained from the rocks of these distant northern countries belong in good part to species already known. Nevertheless the conditions of life then, at least in one particular, must have been very different from those which prevailed elsewhere; for the glacial zone, in ancient geological periods as at present, must have had a long day of summer and a long night of winter. The night lasts nearly a third of the year on the shores of the Ice fiord. In Bear Island the flora of the Carboniferous epoch presents in general not only the same species as those of Europe, but we find in them the slight shades which characterize these species in our countries, and we can have no hesitation as to the phase of the Carboniferous period to which that flora must be referred. This is also the case with the much more recent Miocene flora of Greenland and Spitzbergen. In this we have throughout well-marked species, as in our countries. The marsh-cypress of northern Spitzbergen is exactly the same as that of North Carolina and Virginia. This species has maintained its existence down to our own day; after a number of centuries which it is impossible to estimate, it produces in Virginia the same branches covered with elegant leaves, the same flowers, and the same fruits as formerly in Spitzbergen, on the shores of the Ice fiord.

Is it otherwise with the animal kingdom? The marine animals of Spitzbergen belonging to the Carboniferous, Triassic, and Jurassic formations furnish the same demonstration.

Throughout all these geological ages, even in the extreme north, the same types, distinctly marked, recur. The intermediate forms that the variability of species would necessitate are not met with there.

In the second place, a whole series of new facts, established by the recent discoveries, confirm the opinion that the glacial zone must formerly have enjoyed a climate much warmer than that which it has in our days. This fact springs from the study of all the geological formations from the Carboniferous epoch to the Miocene period. As the flora of the Carboniferous is very different from that of our day, the inductions that we derive from it are not, perhaps, very certain; but the fact that it consisted in great part of trees enables us to conclude with certainty that the temperature was higher than at present. The present limit of trees nearly coincides in the north with the isothermal line of 10° C. (=50° F.) for July and August; that is to say, those two months must have a mean temperature of at least 10° C. in order that trees may live. Further north life is impossible to trees. In the northern hemisphere the normal limit of trees nearly follows the polar circle. But upon this limit we find nothing more than a few scattered conifers, the birch, and the poplar, and even those plants are only represented by stunted individuals. Upon Bear Island, 8° further north, we find, on the contrary, in the Carboniferous deposits, a whole series of acotyledonous trees which, at present, grow for the most part in the tropics without any species reaching the temperate climates of the northern hemisphere.

It would be rash to indicate a precise number for the temperature of this epoch; but we may assert boldly that the Carboniferous flora of Bear Island does not in any way indicate a temperature different from that presupposed by the Carboniferous flora of central Europe. The species are there associated in the same manner; the trunks there are of the same thickness, and denote an equally luxuriant growth; nevertheless Bear Island is 28° further north than the Vosges, where we find the same flora in the Lower Carboniferous. It is therefore probable that at that epoch the earth was not yet divided into zones as regards the distribution of heat.

Other conditions, again, are presented by the Miocene period. The climate of the polar zone must certainly have been warmer at that epoch than at the present day; but if we compare the vegetation of those countries with that of Switzerland at the same epoch, we shall be convinced that there the temperature already diminished in advancing towards the north. The palms in Germany attained a latitude only of 51½° N.; the

laurels and the camphor-trees only went to the shore of the Baltic; the magnolias and evergreen oaks, the walnuts, and the vine advanced in Greenland to the 70th degree; and the marsh-cypress, the thuias, the poplars, the planes, and the limes reached in Spitzbergen to 78°. Although several species traversed all these regions from Italy to Spitzbergen, the character of the vegetation was nevertheless different according to the zones, without being so strongly separated as at the present day, when, however, some species, such as the birch and the pine, are disseminated from the north of Norway to Italy. The temperature decreased much less rapidly in advancing towards the north, so that Spitzbergen still had a temperate climate.

In order to explain this strange phenomenon, various hypotheses, which are now subjects of discussion among naturalists, have been proposed. But I cannot speak of these here, and I may pass over them in silence the more easily because I have already expressed my opinion upon this subject in this very review*. I may, however, be permitted to call attention to a third point.

The recent discoveries made in the extreme north fully confirm the law deduced from the examination of European plants, that the organization of plants becomes more and more elevated with the progress of time. The ancient Carboniferous flora of Bear Island only consists of Acotyledons, whilst the much more recent flora of the Miocene of Spitzbergen consists in great part of phanerogamous plants, the organization of which is higher. Moreover we see the former extending over a much vaster region than the latter; so that the habitat of the species has gone on becoming restricted in the course of centuries. The first-named plants probably issued from a primitive centre; they have in general microscopic seeds, which could fly readily in all directions. The second set, the plants of the Miocene, have probably been propagated starting from several centres; but their diffusion on the surface of the globe must have been slower, on account of the weight of their seeds, which are generally larger. *One of these centres of diffusion was evidently in the polar zone, whence plants and animals have spread in radiating directions.*

We have already seen that Spitzbergen has several species in common with Greenland, as also with the Mackenzie. Quite recently I have received a very interesting fossil flora

* "Les Régions polaires du Nord," Bibl. Univ. January 1867, p. 78 *et seq.* I have treated this subject in greater detail before the Société Helvétique des Sciences Naturelles at Rheinfelden in 1867, and in "Flore fossile des Régions polaires," p. 61 *et seq*

brought from the territory of Alaska, where it was collected by a Finnish director of mines, M. Hjalmor Furuhjelm. Among these plants there are fourteen species of trees and shrubs belonging to Greenland and Spitzbergen; and it is a strange thing that these species are almost solely those which lived at the same time in Germany and Switzerland. It is therefore probable that they came from the glacial zone, which was covered by a uniform vegetation. We see some species advance thence as far as Alaska on one side and on the other to Königsberg: such is *Populus Zaddachi*. Others go in America to Alaska, and in Europe to Switzerland, such is the marsh-cypress; others, again, reach in America to Vancouver's Island, in Europe to Greece, and in Asia to the Ural: such are the gigantic trees *Sequoia Langsdorfii*.

The presence of these plants in the rocks of countries so distant from each other is certainly remarkable, but it may be easily explained if we reflect that all these trees occur in the glacial zone, that they grew there formerly spontaneously, and that they have spread thence by radiating towards the south. The more they advance towards the south, the more scattered are they. We have seen that in the summer innumerable birds collect in the polar countries; they meet there from all parts of the world. In the autumn they separate again to fly away in all directions. What is done in a few months by the birds with their light wings, the plants took centuries and thousands of years to accomplish. Every plant executes a slow and continuous migration. These migrations, the starting-point of which is in the distant past, are recorded in the rocks; and the interweaving of the carpets of flowers which adorn our present creation retraces them for us in its turn. For the vegetation of the present day is closely connected with that of preceding epochs; and throughout all these vegetable creations reigns *one* thought which not only reveals itself around us by thousands upon thousands of images, but strikes us everywhere in the icy regions of the extreme north. Organic nature may become impoverished there, and even disappear when a cold mantle of ice extends over the whole earth: but when the flowers die, the stones speak and relate the marvels of creation; they tell us that even in the most distant countries, and in the remotest past, nature was governed by the same laws and the same harmony as immediately around us.

X.—*On the Existence of distinct Larval and Sexual Forms in the Gemmiparous Oligochætous Worms.* By E. Ray Lankester, B.A. Oxon.

In the 'Quarterly Journal of Microscopical Science' for July I have described the sexual form of *Chætogaster Limnæi*, which differs from the gemmiparous larvæ abounding throughout the year on the *Limnæus* and *Planorbis* in the fact that the number of setæ in each fasciculus is doubled, that there are sixteen pairs of abdominal fasciculi instead of three or four to each individual, that gemmiparity is discontinued, and that a new pair of fasciculi developes between the cephalic and first abdominal pair of fasciculi, four setæ of which on either side are not uncinated and bifid at the apex, but stunted club-shaped organs. These I call "genital setæ." In studying the generative organs of *Naïs serpentina*, which swarms in a very filthy pond on Hampstead Heath, which has furnished me with *Lumbriculus*, *Limnodrilus* (new species), *Enchytræus* (new species), and two other species of *Naïs*, I have observed a somewhat similar change and development of "genital setæ," which do not appear to have been known to Carter (who described the "spermatology" of a species of *Naïs* in this Journal in 1858), nor to the late Jules d'Udekem (in his description of *Stylaria*); nor have they been mentioned by M. Edouard Claparède, to whom, however, I dare say they are known, since he has studied a species of *Naïs*, but, I believe, has not published the description of it among his other invaluable contributions to this branch of zoology. I therefore conclude that these modified setæ and their position are unrecorded hitherto.

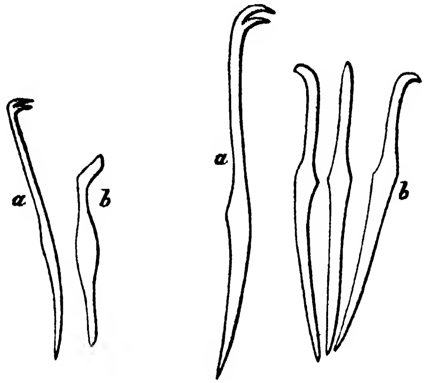
In *Naïs serpentina* and other species of *Naïs*, five pairs of ventrally placed fasciculi succeed to the mouth, indicating a pharyngeal region. There are no dorsal setæ in this region. Immediately after the fifth pair the intestine commences; that is to say, the alimentary canal is contracted and its walls are covered by a layer of coarse cells—the so-called hepatic tunic. Corresponding to the sixth pair of ventral fasciculi is a pair of dorsal setæ, thick, short, and awl-shaped in *N. serpentina*; these continue thenceforward, along the body, with the ventral setæ. The bristles of the ventral setæ are curved, with a hooked bifid apex; two, with a growing third, is the usual number in a fasciculus. When the generative organs commence their development, the distance between the fourth and fifth ventral fasciculi enlarges very considerably, and a new pair of fasciculi makes its appearance, placed a little nearer the middle line, and therefore closer together, than the other fasci-

culi. The bristles in these new fasciculi are shorter and stouter than those of the normal ventral fasciculi, and *are not bifid* at the apex; they are three in number in each fasciculus, rarely four. At the same time that these make their appearance, the normal ventral fasciculi acquire another bristle in each, making thus three, with a growing fourth, or even four complete, instead of two and three. The *genital setæ* which thus develope in the new genital segment are placed close to the orifices of the male generative glands, the duct connected with them being simple and unciliated. In front of the fourth pair of ventral fasciculi are two orifices corresponding well in position with the genital setæ and their orifices; and these open into very large sacs, containing flat rhombic crystals and curiously coiled fibrous whisps and spermatozoa—the seminal receptacles. The clitellus, which, as all know who have studied the Oligochæta, is the most obstructive institution on account of its opacity, extends from the fourth to the seventh fasciculus (not counting the genital fasciculus in the numbering).

I do not wish now to give a detailed account of the generative organs of *Naïs*, which I hope shortly to publish elsewhere; but I desire to call attention to this development of a *new segment* between the larval fourth and fifth fascicular segments, and provided with fasciculi carrying a special form of genital setæ. For the greater part of the year these worms, like *Chætogaster*, reproduce gemmiparously under a certain well-known form; suddenly gemmiparity ceases, and a new development, of which there was no previous indication, takes place: a new segment, a new integral factor of the worm, makes its appearance with a new form of setæ; the setæ in the normal fasciculi also increase in number. This is not the mere growth of generative organs occurring in due order of development, but is really more strictly comparable to cases of metamorphosis, the gemmiparous form being a larva, as the agamogenetic *Cecidomyia* is a larva, and the sexual form the perfect or imaginal condition. Very few of the immense numbers of gemmiparously produced *Naïdes* or *Chætogastres* ever proceed to acquire the perfect form,—*Chætogaster Limnæi* only in October apparently, *Naïs serpentina* in June, but perhaps also at other seasons.

There is, as far as I know, nothing described comparable to this development of a new segment and of genital setæ in the other Oligochæta; but, on inquiry, indications of it may hereafter be found. The setæ in the region of the clitellus in *Limnodrilus*, in *Tubifex*, in *Clitellio*, and others remain normal, or drop out and are not replaced.

Among Polychætous Chætopoda the Syllidæ present very remarkable differences between the gemmiparous and sexually reproducing conditions, to which the cases here described make a small approach.



Chætogaster Limnæi. *Nais serpentina.*

a. Normal uncinate setæ; *b*, genital setæ.

XI.—*On the Early Stages in the Development of* Phyllodoce maculata, *Johnston.* By W. C. M'Intosh, M.D., F.R.S.E., F.L.S.

[Plate VI.]

Professor Sars seems to have been amongst the first to notice the young of *Phyllodoce**, although he was unaware of the group of Annelids to which his young forms belonged. At the end of his paper on the development of *Polynoë cirrata*, Linn. (*Harmothoë imbricata*), he mentions that he had also found, off the Norwegian coast, in February and March, globules composed of irregularly rolled mucous ribands, which adhered to *Zostera marina* and *Fucus vesiculosus* at the depth of some feet. These mucous masses with their grass-green ova in all probability refer to the species hereafter to be described. He observed that the young, on their exit from the egg, had a central circlet of cilia and two kidney-shaped eyes of a bright-red colour. He does not mention a mouth, but states that the anus is at the posterior end of the body, and more visible than in the young of *Polynoë*. His figure is somewhat small and indistinct, but it would appear to repre-

* Wiegmann's Archiv, 1845, and Ann. Nat. Hist. 1845, vol. xvi. p. 187.

sent the animal just after it leaves the gelatinous investment and assumes a more elongated form. Dr. Max Müller*, in his description of *Sacconereis helgolandica*, refers in a footnote to a young *Phyllodoce* from Heligoland, which, however, had reached a recognizable condition, being furnished with twenty-six segments, each of which had the characteristic bristles and other appendages of the feet. Mr. Alex. Agassiz† lately added still further to our information on the subject by his remarks on the development of *Phyllodoce maculata*, Œrsted, his description commencing at an earlier period than that referred to by Dr. Max Müller in his form,—viz. on the appearance of the tentacles, but before the advent of the bristles.

On the 15th of May various examples of the adult Annelids, loaded with ova and spermatozoa, were received from St. Andrew's; and each very soon deposited the green spawn on the sides of the vessel in a somewhat bulky, transparent, gelatinous mass, and discharged at the same time a copious cloud of spermatozoa. On deposition, the ova (Pl. VI. fig. 1) are of a fine grass-green colour, minutely granular, with a clear spot and a single thin investment. The bodies of the spermatozoa are shaped somewhat like a nine-pin, with a small rounded head, towards which the body tapers anteriorly, and with a blunt posterior extremity which gives origin to the long filament or tail (fig. 2).

To take for instance the ova deposited about 7 A.M. on the 18th, it is found at 9 A.M. that the yelk is separated into two masses (fig. 3), and moreover that, when moderate pressure is maintained for a time, a further division into four occurs (fig. 4), and in a few hours after all are found in the mulberry-stage. Next day the exterior of the ovum becomes distinctly ciliated, though the action is feeble and the organs short (fig. 5). There is no extrusion out of an egg-capsule in this case, the thin investment of the yelk being the only covering. The body is nearly round, and at first sight seems to be covered with cilia; but a brief examination in various positions shows that these organs are arranged thus:—A belt of cilia entirely surrounds the body, a long brush springs from a point a little behind the anterior border, and a shorter tuft of scarcely projecting cilia marks the large aperture in the posterior region. The cilia of the ring gradually increase in length and power; so that swarms of the young leave the gelatinous mass and con- [illegible] On the third day they have become much more lively, and two eyes also appear (fig. 6). When, in this stage, the animal is viewed from

* Archiv für Anat. 1855, p. 17.

† Ann. Nat. Hist. ser. 3. vol. xix. p. 249, 1867.

the anterior end or snout (fig. 7), it is found to be surrounded by a ring of cilia, and to have the digestive tract clearly defined as a more opaque central mass, the eyes, in this position, being placed outside the latter. Next day their powers of progression have still further increased, and they course throughout the vessel like a swarm of dancing particles. Instead of being nearly circular, the body is now more elongated (fig. 8), the anterior end being blunter and rounder, the posterior somewhat more tapered. A distinct constriction marks the seat of the ciliated belt. When viewed from the front, the rounded anterior end presents the appearance shown in fig. 9, the very great length of the cilia being in strong contrast with the drawing of the same aspect at an earlier period. The body is cellulo-granular, opaque in the centre, more translucent at the edges, and, when crushed, resolves itself into nucleated cells and granules (fig. 10). The anterior brush of cilia is placed at some distance behind the anterior end, apparently on the same surface as the large ciliated aperture, and hence is not well seen unless the animal is turned round on one side, as in fig. 11. The anterior region of the digestive canal is richly ciliated, and under favourable pressure becomes everted (fig. 12), but by what aperture (natural or artificial) I have not yet been able to determine with precision.

During the subsequent days, the body becomes more elongated, the cutaneous tissues are differentiated, and the digestive tract especially assumes a definite shape. Coarser granules and granular cells mark the latter under pressure; and it is also distinguished from the paler body-wall by its deep-green hue and the distinct contractions of its muscular investment. The animal now feeds, and the intestinal canal holds numerous granules and sand-particles. The large aperture towards the posterior end is surrounded by a strong belt of circular fibres. The anterior part of the body is still bluntly rounded; and the eyes are situated about midway between the tip and the ciliated ring. The cilia of the latter have much increased in length, so that under a powerful lens the animal somewhat resembles a winged wedge.

At the end of a fortnight they all showed a tendency to perish without further differentiation of textures; so that for the present the inquiry had to be relinquished.

Mr. Alex. Agassiz* makes a remark in regard to his form, the youngest of which was much older than the most advanced just described, which does not seem to coincide with my observations; for, in describing its structure, he says, "There is as yet no exterior communication from the digestive cavity,

* *Loc. cit.*

which is simply blocked out, occupying little more than two-thirds of the space in front of the vibratile ring and of the large shield extending behind it: when seen in profile (fig. 47, upper figure), the cavity is somewhat retort-shaped, and occupies mainly the dorsal portion of the embryo." In the much younger animals examined by me, the large aperture behind the ciliated ring is very conspicuous, and assumes various shapes in regard to contraction and dilatation. From the posterior border of this opening a series of short cilia proceed towards the tip of the body; but, as their distribution is limited, they are not very evident in all views. No aperture was seen at the posterior termination of the body, neither was any made out at the anterior ciliated tuft. This large aperture behind the ciliated ring (supposed by Prof. Sars to be the anus) would therefore appear to be the mouth—an interpretation in accordance with what is found in other young Annelids, such as *Polynoë*. The ciliated ring is a very common arrangement in the Annelidan young, the homologue thereof appearing even in the Nemerteans, for instance, in the temporary tufts of long cilia on the snout (in front of the mouth) of the developing *Cephalothrix filiformis*. The Nemertean young are ciliated all over—a distinction between them and the Annelids, however, that has exceptions. A. Krohn and A. Schneider*, for example, describe a young bristled form from the Mediterranean, entirely covered with cilia in the early stage.

EXPLANATION OF PLATE VI.

Fig. 1. Newly deposited ovum of *Phyllodoce maculata*, Johnst., surrounded by spermatozoa, × 350 diameters.

Fig. 2. Spermatozoa of the same species, drawn under a power of 700 diameters.

Fig. 3. The ovum, with the yelk separated into two divisions, × 350 diams.

Fig. 4. The same, separated into four divisions, × 350 diams.

Fig. 5. Rounded embryo shortly after the appearance of the cilia, × 350 diams.

Fig. 6. Embryo somewhat older, and having two eyes, and longer oral and lateral tufts of cilia (the latter of course arising from the ciliated ring under pressure), × 350 diams.

Fig. 7. A younger embryo than the foregoing, viewed from the anterior end, and slightly compressed. The digestive chamber is clearly mapped out.

Fig. 8. Embryo about five days old, seen from above, almost in its normal state as regards pressure, × 350 diams.

Fig. 9. The same, viewed from the anterior end, uncompressed, × 350 diams.

Fig. 10. Elements of compressed and disintegrated animal, × about 700 diams.

* Archiv für Anat. 1867, p. 498, Taf. 13. f. 1 & 2.

Fig. 11. Embryo of the same age as fig. 8, turned round and much compressed, so as to exhibit the anterior whip of cilia and the large aperture behind the vibratile ring, × 350 diams.
Fig. 12. One of the same age, in which compression has forced out the ciliated proboscis, × 350 diams.

XII.—*Descriptions of five new Species of Birds from Queensland, Australia; and a new Humming-bird from the Bahamas.* By JOHN GOULD, F.R.S. &c.

Eopsaltria leucura, Gould, n. sp.

Forehead, lores, and a line nearly surrounding the eye and the ear-coverts black; head and upper surface dark leaden grey, fringed posteriorly with greyish white; wings blackish brown, darkest on the shoulders; upper tail-coverts black; two centre tail-feathers black; the next on each side black, with a stripe of white on the basal part of the shaft and outer web; the remaining four on each side white at the base, and black for the remainder of their length; all the under surface and the under tail-coverts white, with the exception of a broad band of pale grey across the breast; bill and feet black.

Total length $6\frac{1}{2}$ inches, bill $\frac{12}{16}$, wing $3\frac{1}{4}$, tail 3, tarsi 1.

Habitat. The Cape-York district.

Remark. This is the largest species of the genus yet discovered; it is somewhat allied to the *Eopsaltria leucogaster* of Western Australia, but is distinguished from that and every other known species by the white at the basal portion of the lateral tail-feathers.

I have for a long time entertained a belief that there is yet another undescribed species of *Eopsaltria* inhabiting Queensland and the eastern portion of New South Wales—in other words, or to make the matter more clear, that there are three yellow-bellied species resident in the southern and eastern portions of Australia. If this opinion be correct, I have committed the error of figuring the undescribed one in my folio work on the birds of that country under the erroneous specific appellation of *australis*.

The three species may be thus defined:—

Eopsaltria australis.

Crown of the head, nape, and ear-coverts grey; rump dull wax-yellow; chin greyish white; under surface bright yellow.

Syn. *Muscicapa australis*, Lath. Ind. Orn. Suppl. p. li.
Southern Motacilla, Motacilla australis, White's Journ. pl. at p. 239.

Eopsaltria chrysorrhos, Gould, n. sp.

This bird is rather larger than *E. australis*, and is similar in colour, except that the rump as well as the breast is of a beautiful jonquil-yellow.

Habitat. The eastern part of New South Wales and the southern portion of Queensland. The validity of this species depends upon whether the two sexes are alike in having the rump of a jonquil-yellow, and on the male and female of *E. australis* having the same part dull wax-yellow.

Syn. *Eopsaltria australis*, Gould, Birds of Australia, vol. iii. pl. 11.

Eopsaltria magnirostris, Ramsay.

Like the last in colour, but having a conspicuously larger bill and shorter wings.

Habitat. Rockingham Bay, Queensland.

Ptilotis Cockerelli, Gould, n. sp.

Male. Fore part of the head grey, merging into the brown of the upper surface, which has a mottled appearance, owing to each feather being of a darker hue in the centre; lesser wing-coverts dark brown, with a spot of dull white at the tip of each, forming a spotted band across the shoulder; greater coverts and primaries dark brown margined with wax-yellow; tail brown, the lateral feathers margined externally at the base with wax-yellow; ear-coverts silvery, with a few of the anterior feathers pale yellow, and a posterior tuft of rich gamboge-yellow; throat and breast clothed with narrow lanceolate white feathers, a few on the sides of the chest tinged with deep yellow; abdomen dull greyish white, changing to a creamy tint towards the vent; bill black; feet horn-colour.

Female. In colouring differs only in the spots at the tips of the lesser wing-coverts being nearly obsolete, but, as is the case with many other species of the family, is much smaller than the male, as will be seen by the following admeasurements:—

Male.	Total length 5 inches,	bill 1,	wing $3\frac{1}{8}$,	tail $2\frac{3}{4}$,	tarsi $\frac{3}{4}$.
Female.	„ 4 „	„ $\frac{3}{4}$	„ $2\frac{3}{4}$	„ $2\frac{1}{2}$	„ $\frac{5}{8}$

Habitat. The little-explored districts of the Cape-York peninsula, where it was shot by Mr. Cockerell, after whom I have named it.

Remark. Although I have placed this beautiful new species in the genus *Ptilotis*, I am by no means certain that I am correct in so doing; for the bird possesses characters which ally it to at least three genera, namely, *Stigmatops*, *Meliphaga*,

and *Ptilotis*, while it also possesses characters peculiar to itself of almost sufficient importance to demand a distinct generic appellation. It somewhat resembles in its colouring the *Ptilotis polygramma* of Mr. G. R. Gray (*vide* Proc. Zool. Soc. 1861, pp. 429, 434).

Sittella striata, Gould, n. sp.

Male. The whole of the head, neck, throat, and breast black; all the upper surface pale-brown, with a blackish-brown stripe down the centre of each feather; under surface striated in a similar manner, but the streaks are narrower, not so dark, and the edges of the feathers are also lighter, and on the centre of the abdomen are nearly pure white; primaries black, with a large spot of white near their base, and faintly tipped with brown; secondaries dark brown margined with pale brown; upper tail-coverts white; under tail-coverts white, with a large tear-shaped spot of dark brown in the centre of each; tail black, the lateral feathers tipped with white, increasing in extent as the feathers recede from the centre; circle round the eye, base of the bill, and the legs and feet yellow; tip of the bill black.

Total length 4 inches, bill $\frac{5}{8}$, wing 3, tail $1\frac{1}{4}$, tarsi $\frac{5}{8}$.

Female. Differs in having the crown and nape only black, and in the striation of the under surface extending from the bill to the vent.

Habitat. The Cape-York peninsula.

Remark. So far as I am aware, no member of this genus has been found out of Australia; but one or other of the many species known are distributed over all parts of that great country.

The nearest ally of the bird above described is the *Sittella leucocephala* of the Moreton-Bay district, to the north of which country nature has completely rung the changes by colouring the head and neck of the present bird black, instead of white, as in the species mentioned. The sexes of this new species are very different, the female (or what is supposed to be an example of that sex) having the crown of the head only black, while the upper and under surface is streaked as in the male.

Gallinula ruficrissa, Gould, n. sp.

Head, all the upper surface, wings, and tail brownish olive; sides of the face, neck, breast, and under surface deep olive-grey; lower part of the flanks, vent, and under tail-coverts pale rusty red; bill greenish yellow, with a mark of red on the base of the culmen; legs and feet greenish yellow.

Total length 10 inches, bill 1⅝, wing 6, tail 2¼, tarsi 2½, bare space above the tarsal joint 1⅛, middle toe and nail 2¼.

Habitat. Cape River, Queensland.

Remark. This bird appears to be most nearly allied to the *Gallinula olivacea* of Meyen (*vide* Nov. Acta, 1834, p. 109, tab. 20); but that species is of larger size, and has legs still more disproportionate to the size of its body. The white-breasted Indian Gallinule (*G. phœnicura* of Pennant) and the *Gallinula akool* of the same country are, in my opinion, also nearly allied to it.

Prof. Reichenbach has instituted the genus *Amaurornis* for the reception of *Gallinula olivacea*, with which the late Prince Bonaparte associates the *G. femoralis* of Tschudi. It is for ornithologists to decide upon the propriety of this subdivision.

Family **Trochilidæ**.

Having lately received, through the kindness of His Excellency Sir James Walker, Governor of the Bahama Islands, four specimens of a Humming-bird, of which for the last twenty years I have been anxious to procure examples, I feel convinced that, as I had for some time supposed from a conversation I had with the late Dr. Bryant, two species of this lovely family of birds inhabit those islands; and this conviction is strengthened by the circumstance that when in England, just prior to his lamented death, he informed me that the humming-bird of the southern islands was supposed to be distinct from that killed in the neighbourhood of Nassau. He at the same time promised that I should have any examples that he could spare from his collection—a promise which has been partly performed either by Mrs. Bryant or her husband's executors sending me, through Mr. G. N. Lawrence, of New York, a male, which I find is different from those sent me by Sir James Walker. As the birds killed round Nassau are identical with the type of the genus *Doricha* (*D. Evelynæ*), which is still in the Loddigesian collection, the southern bird requires a specific appellation; and it would have given me great pleasure to name it after its discoverer, had not another species of the same section of the Trochilidæ been named *Bryantæ* by Mr. Lawrence.

The new bird, which is probably from Long Island, possesses some peculiarly interesting specific characters. I say from Long Island, because, on reference to the chart consulted by Dr. Bryant and myself during his last visit to my house, I find that is the locality marked as being the place in which he procured some of his specimens.

In size the new species, which I propose to call *Doricha*

lyrura, is about the same as *D. Evelynæ*; but the tail is distinctly forked, and its outer feathers are much longer, narrower, and outcurved at the apex, while the remainder regularly graduate towards the two central ones, which are very short. When the tail is raised and the feathers partially spread, they assume a lyre-like appearance, and hence the specific appellation. Not wishing to depend upon my own judgment alone, I submitted this bird to the inspection of Mr. Salvin, who, after a careful examination, came to the same conclusion as myself, that the bird is distinct, and that the form of the feathers just described is the natural one. All my Nassau specimens, as well as others I have seen from that district, have the beautiful luminous lilaceous feathers confined to the throat, while in the specimen sent to me through Mr. Lawrence, the whole face is luminous, the metallic lilaceous colour extending across the forehead.

Doricha lyrura, Gould, n. sp.

Forehead, throat, and breast beautiful shining lilac bordered with blue, the two colours blending at their juncture; immediately below the gorget a band of greyish white, remainder of the abdomen bronzy brown; axillæ rusty red; wings purplish brown; upper surface golden green; the narrow outer tail-feather on each side black, the two next black on the outer web, chestnut-red on the inner one, the next blackish brown with green reflections; the two middle ones green.

Total length $3\frac{5}{8}$ inches, bill $\frac{7}{16}$, wing $1\frac{1}{2}$, tail $1\frac{7}{8}$.

XIII.—*On the Depths of the Sea.* By Prof. Wyville Thomson, LL.D., F.R.S.*

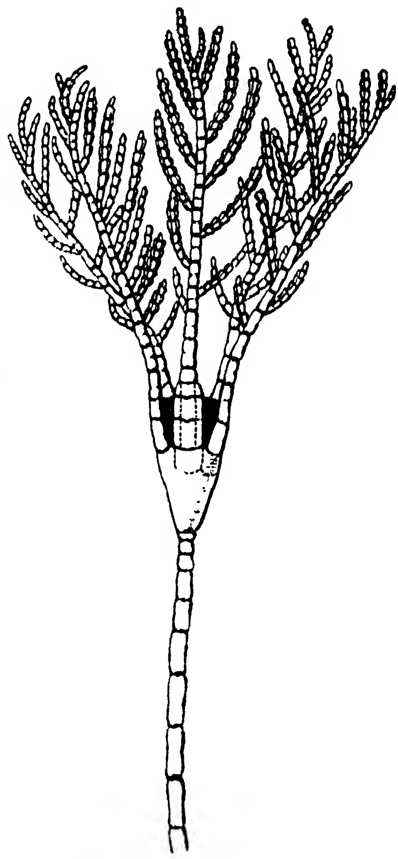
In the year 1864, and in succeeding years, G. O. Sars, a distinguished son of the veteran and very distinguished Professor of Zoology in the University of Christiania, was employed as a Commissioner of Fisheries in the service of the Swedish Government; and in his official capacity he had an opportunity of dredging in deep water (300 fathoms) off the Lofoden Islands, within the arctic circle. Instead of finding the bottom of the sea barren at these great depths, as many circumstances had led many of our most able naturalists to anticipate, he brought up a multitude of animal forms, all of them of the

* Communicated by the author, being the substance of a lecture delivered, on the 10th of April, 1869, in the theatre of the Royal Dublin Society.

highest interest both from their biological and their geological relations; and many were new to science.

One animal form, of which about seventy specimens were found, was of surpassing interest. It was a "Crinoid"—a stalked starfish, with a delicate thread-like stem three or four inches long, and a head at first sight very closely resembling that of the pentacrinoid larval stage of a feather-star which is common in deep water off the Norwegian coast. A careful examination, however, showed that the crinoid was mature, and that it belonged to a totally distinct family of the order, hitherto only known fossil, and supposed to be almost entirely confined to the Mesozoic series of beds. This family is called the Apiocrinidæ, from the characteristic genus *Apiocrinus*, of which the species best known in this country is the "pear-encrinite," which was got in great abundance in a bed of Great Oolite exposed in cutting the tunnel through Box Hill. The group seems to have attained its maximum during the period of the deposition of the oolitic beds in the European area. It is not represented in the earlier formations; but we find handsome well-developed species belonging to several genera in the Jurassic beds on the Continent. In the lower beds of the chalk there are two or three somewhat obscure forms; while in the white chalk the family, so far as we know, is represented by a single species of a single genus, *Bourgueticrinus ellipticus*, in which the head

Fig. 1.



Rhizocrinus lofotensis (Sars).
(Four times the natural size.)

and arms are greatly reduced in size and development, the stem is much branched, and its joints are indefinitely and irregularly multiplied, which shows, in fact, all those peculiarities which we are accustomed to associate with comparative degradation in the animal scale. In the Tertiary formations there are only some obscure traces of one or two small forms of the group. *Rhizocrinus lofotensis* of Sars stands in nearly the same relation to the *Bourgueticrinus* of the English Chalk as *Bourgueticrinus* to the Apiocrinites and Millericrinites of the Oolite. It is much smaller; the stem is even larger in proportion to the cup and special organs of nutrition; and here alone among known Crinoids we meet with a character which would indicate marked degradation— an irregularity in the number of the arms, of which there are sometimes four, sometimes five, and sometimes even six. It looks like a *Bourgueticrinus* which had been going to the bad for a million of ages, and was somehow getting worsted in the "struggle for life."

Rhizocrinus seems to be very generally distributed: Dr. Carpenter and I dredged it last summer off the north of Scotland; and about the same time Count Pourtales, who was investigating the opposite border of the Gulf-stream in connexion with the American Coast Survey, found it off the reefs of Florida.

Two living stalked Crinoids are well known as inhabiting deep water in the sea of the Antilles, and apparently some other localities in the Indian and Australian seas; but they belong to a parallel family, which has come down continuously, usually represented by only a few species, from the period of the deposition of the English Lias. The remarkable point is the discovery of a representative, living at great depths in modern seas, of a family which had dwindled away and apparently become almost extinct before the formation of the older Tertiaries. No discovery in natural science so suggestive as that of the younger Sars had been made for many long years; it set many of us pondering on the distribution and conditions of life in the depths of the sea.

The questions involved are very complicated. The late Prof. Edward Forbes was the great authority on the distribution of marine life; he and his friend the late Dr. Robert Ball initiated the use of the dredge; and Forbes defined certain zones of depth which he held to be inhabited by special and characteristic groups of animals. The last of these was the abyssal or deep-sea zone; and he supposed that in this zone, which extended downwards from the 100-fathom line, life gradually became more and more scarce, till, at a depth of

about 300 fathoms, it altogether ceased. Forbes's experience was much wider than that of any other naturalist of his time; the practical difficulties in the way of testing his conclusions were great, and they were accepted generally by naturalists without question. There was, besides, a popular impression that the conditions a mile beneath the surface of the sea must be so very peculiar as to make it difficult to conceive that animals, more or less nearly related to forms inhabiting the upper world, could exist there; accordingly no attempt was made to dredge at great depths, except on the Scandinavian coast; and the results of the scattered observations made there have only appeared within the last few years. Except in one or two cases which never became very generally known, all the few creatures which came up to protest against Forbes's theory came clinging to sounding-lines, and were valueless for absolute proof, as their mode of capture constantly involved the question, which at that time we were unable to answer, whether there might not be pelagic forms of the groups to which they belonged.

In the year 1860, H.M.S. 'Bulldog' sounded over the Atlantic plateau; and shortly after her return, Dr. Wallich, the surgeon-naturalist who accompanied her, published a warm and able defence of the bottom of the sea as an inhabited region. The evidence of the existence of highly organized forms at great depths was not even yet, however, quite conclusive, as it still depended on starfishes clinging to lead-lines; and although, from want of data, the subject was little discussed, the feeling of naturalists seemed still to be in favour of Forbes's "zero of animal life."

The Cruise of the 'Lightning.'—About the time of Sars's explorations in Lofoden, my friend Dr. Carpenter and I were engaged in some investigations which made the discovery of *Rhizocrinus* especially interesting to us; and we talked over, again and again, the curious questions, both geological and biological, which Sars's dredgings suggested. We finally arranged that I should write a letter to Dr. Carpenter, who was then Vice-President of the Royal Society, sketching out what I conceived to be a promising line of inquiry, indicating generally the results which I anticipated, and urging him to endeavour to induce the Council of the Royal Society to apply to the Admiralty for a vessel fitted with dredging-gear, that, among other questions, the question of deep-sea life might, if possible, be settled definitely, by bringing up a quantity of the bottom, with its inhabitants, if there were any, along with it. The Council of the Royal Society acceded to Dr. Carpenter's request; and the Admiralty

most liberally placed the surveying gunboat 'Lightning' at their disposal, under the able and genial command of Staff Commander May. On the 11th of August last, Dr. Carpenter and I left Stornoway, and steamed northwards towards the Faroe Islands. We had shocking weather; indeed during the whole of the cruise, which lasted nearly six weeks, we could only use the dredge on nine days, and only on four in deep water. We dredged a little on the Faroe banks, with small results, and on the 17th of August we reached Thorshaven, the capital of the Faroe Islands. We spent several days exploring the fjords of that hospitable but hazy land, where it seems never to be afternoon, but always grey misty morning or night. On the 26th we left Thorshaven, and were driven by dirty weather to the south-eastward. This was perhaps fortunate; for it forced us to examine more carefully than we might otherwise have done the "cold area," to be mentioned hereafter, where the bottom was of stones and coarse sand, where the thermometer registered a minimum of 32° F., and where the fauna consisted of a meagre sprinkling of boreal and arctic forms. On the 4th of September we dredged in 530 fathoms, the thermometers registering a minimum of 47°·5 F., and brought up a mass of fine, grey, slimy mud, technically called "ooze," but which I shall now call "chalk-mud." We traced the area having this high temperature, which we may call the "gulf-stream area," southwards and westwards, in a line between the plateau of the Faroes and the north coast of Scotland; and Dr. Carpenter afterwards followed it as far north as lat. 61°. It is to this area and its geological and biological relations that I wish specially to direct your attention.

Chalk-mud and Chalk.—During the last twenty or thirty years, very great improvements have been made in sounding-apparatus, so that depths can now, as a general rule, be ascertained with a tolerable amount of precision. By two or three very ingenious contrivances, cupfuls or little bucketfuls of the bottom may be brought up by the sounding-line: one of these, contrived by Lieut. Fitzgerald, R.N., which we used in the 'Lightning,' is exceedingly clever; I never knew it to fail. The laying of the cable directed special attention to the sounding of the North Atlantic; and in 1857 Capt. Dayman, and in 1860 Sir Leopold M'Clintock accompanied by Dr. Wallich, and afterwards several others, sounded the area, and brought home what specimens of the bottom they could procure. The result of the sounding was the definition of the great telegraph plateau, stretching from Valentia nearly to Newfoundland, with an average depth of 2000 fathoms, with greatly deeper depths

extending southwards towards the Azores. The result of the examination of the soundings was that the bottom in all cases consisted of a fine calcareous mud, of countless myriads of the shells of a Rhizopod, *Globigerina*, and of some very peculiar bodies, which have been called Coccoliths and Coccospheres. In the meantime, naturalists were examining the microscopic structure of the white chalk; and they found it to consist of fine calcareous particles, *Globigerinæ* and other Foraminifera, and Coccoliths and Coccospheres. The structure of the chalk was, in fact, identical with that of the chalk-mud of the Atlantic. One might have thought that these deep-sea soundings should have settled the question of the existence of life in the depths of the ocean; but they were all open to the objection that the *Globigerinæ* and other organisms could not be shown to be absolutely living, and it was conceivable that they might have lived nearer the surface, and have sunk to the bottom after death.

All over the "warm area," our dredge brought up little else than the *Globigerina*-mud—not now, however, pure. The dredge brought up about a hundredweight at a haul. On one occasion, a little way to the south of the Faroes, it brought up, mixed with the mud, about forty sponges, living, with the delicate and exquisitely formed spicules suspended in the transparent sarcode. Most of these sponges had long and venerable beards of flint, spreading in all directions through the chalk-mud. These beards brought up, entangled in them, small clams, starfishes, and minute crustaceans; and among the mud were scattered the shells of the beautiful and well-known Pteropods of the Gulf-stream.

There can be no doubt whatever, indeed it is admitted by all microscopists, that chalk is now being formed in the depths of the Atlantic; but an idea which suggested itself to us even before we proposed our cruise has now ripened into a conviction, that it is not only chalk which is being formed, but *the Chalk*—the chalk of the Cretaceous period. There is one abyss in the Atlantic in which the Himalaya Mountains might lie with the waves rolling over them unbroken; and there is no direct evidence that oscillations have taken place in the north of Europe or in North America since the deposition of the earlier Tertiaries, beyond 1500 feet; in fact there is a very strong presumption that the main features of the contour of the crust of the earth have altered but little since the commencement of the Mesozoic period, and that the great depressions, the Atlantic, the Pacific, and the Antarctic Oceans, are due to causes which acted even before that very remote epoch. There have been constant minor oscillations; but the beds

formed during the periods of depression, and now exposed by an upheaval of this minor character, are all comparatively local and shallow-water beds, as shown by the nature and the richness of their faunæ. To put this in another form: there is no reason to suppose that either the physical or the biological conditions of two-thirds of the ocean have been affected by the oscillations which produced the varying distribution of the sea and land and the local modifications and migrations of faunæ during the Tertiary period. No doubt the temperature of the different portions of the deep sea has altered again and again, owing to geographical changes influencing the distribution of the minor currents and the branches of the great currents; and it is to the accumulation of these slight changes through countless ages that we must look as the cause of the gradual modification of the fauna of the chalk, of the extinction of some animal groups, and the greater development of others. A bit of the edge of the Cretaceous formation has been tilted up, to form the white cliffs of Albion and the chalk-beds of France; but the great mass of the formation maintains nearly the same character, and is now entombing the same group of organisms, among the Philippines, off the coast of Spain, in the seas of Japan, near the coast of Massachusetts, off the Faroes, and to the extreme Lofoden Islands. I imagine that this is one of the *great formations*—one of the corner-stones in the building of the earth, formed slowly in vast areas of subsidence, which will only make its appearance in mass along with a complete change in the distribution of land and sea, and which may be expected in some places to resist denudation, and to stand like the mountain-limestone, as one of the odd pages of a future geological record. Some great peculiarities in the distribution of the Miocene land flora have led to the idea that one of these minor oscillations may have depressed the "telegraph plateau" during later Tertiary times. It may be so, though I think the evidence is very unsatisfactory; but it is by no means necessary that every part of the present cretaceous basin should have been sea throughout; whenever it was sea, however, it was continuous in space with a sea which had been continuous in time (probably, at all events, from the commencement of the Jurassic period), and was peopled from that sea. If these views prove correct, they must modify considerably our interpretation of geological history.

Chalk-flints.—There is one point in the structure and composition of the white chalk which distinguishes it, in the most marked way, from the modern deposits of the Atlantic. Modern soundings and dredgings from all depths are full of delicate sili-

ceous organisms of the most varied and beautiful forms—shields of diatoms, spicules of sponges, and the wonderful netted skeletons of the Polycystina. The soft calcareous mud is the home of multitudes of exquisitely formed glassy and other siliceous sponges; the chalk, on the other hand, may be said to contain no disseminated silica whatever. When chalk is dissolved in acid, a few grains or crystalline fragments of silica remain; but these are apparently all of inorganic origin—fragments of mineral matter. Instead, however, of disseminated siliceous organisms, we have, in the chalk, bands and lines of flints—lumps of amorphous silica, which seem to have filled up and taken the shape of any cavities already existing in the beds. Many of these flints are apparently quite shapeless; but many of them (such as the so-called "paramoudras" of the Antrim chalk) have more or less distinctly the form of large cup-like sponges. Often the shell of a sea-urchin forms the mould of a flint, which fills it entirely, reproducing in relief on its external surface every suture and perforation of the inner surface of the shell. The conclusion seems to be irresistible, that in some way which we do not as yet thoroughly understand, but to which some late observations of the Master of the Mint seem to promise a clue, the organic silica, if I may use the expression, is dissolved out of the calcareous matrix; the solution percolates into and through the cavities, the water being gradually drained from the silica, which is in the colloid state, by the walls of the cavities acting as porous media, till, on the water being nearly or entirely removed, the silica "sets" into flint. In the white chalk of England there is an exceedingly beautiful group of fossils, called Ventriculites, which have greatly puzzled palæontologists. They have usually the form of graceful vases, tubes, or funnels, variously ridged or grooved or otherwise ornamented on the surface, frequently expanded above into a cup-like lip, and continued below into a bundle of fibrous roots. The minute structure of these bodies shows an extremely delicate tracery of fine tubes, sometimes empty, sometimes filled with loose calcareous matter dyed with peroxide of iron. We have been in the habit of regarding the Ventriculites as an extinct group, specially characteristic of the chalk; but, after examining several species, and studying carefully Mr. Toulmin Smith's excellent observations on their structure, I now thoroughly believe that they were siliceous sponges, nearly allied to, if not identical with, the recent order PORIFERA VITREA, and that the silica of their spicules was removed, and went to add to the jelly-like material of the flints, leaving the moulds only in the chalk. Ventriculites are not extremely common in the white chalk, nor are they very

large; and, so far from being extinct, my belief is that the group has attained probably a much higher development in our times—that while the pear-encrinites have been losing ground, the Ventriculites have been gaining it. One haul of our dredge in the soft, warm, oozy chalk-mud off the north of Scotland brought up from a depth of 500 fathoms upwards of forty specimens of vitreous sponges. Many of these were new to science, and some of them resembled closely the beautiful Venus's Flower-basket of the Philippines, while among them were probably two species of *Hyalonema*, the strange glass-rope sponge of Japan. Four specimens of this wonderful new form of vitreous sponge, which I exhibit (see woodcut, fig.2), were brought up in this haul. They were loaded with their glairy sarcode, and had evidently been buried in the ooze nearly to the lip. When one looks at the exquisite symmetry of these organisms, one almost wonders at the recklessness of beauty which produces such structures to live and die, for ever invisible, in the mud and darkness of the abysses of the sea. I dedicate with great pleasure, the new genus to which this sponge must be referred to our kind and hospitable friend, His Excellency M. Holten, the Governor of the

Fig. 2.

Holtenia Carpenteri (Wy. T.).
(Half the natural size.)

Faroe Islands, who showed the greatest interest in the success of our expedition, and on the verge of whose dominions it was found. I dedicate the species to my distinguished colleague, Dr. Carpenter. The mud was entirely filled with the delicate siliceous root-fibres of the vitreous sponges, binding it together, and traversing it in all directions, like hairs in mortar. This mud was actually alive; it stuck together in lumps, as if there were white of egg mixed with it; and the glairy mass proved, under the microscope, to be living sarcode. Prof. Huxley regards this as a distinct creature, and calls it "Bathybius." I think this requires confirmation. Every fibre and spicule of each sponge has its own special sheath of sarcode; and the glairy matter in the mud may, I think, be simply a sort of diffused mycelium of the different distinct sponges. This view accords well, I believe, with the mode of nutrition of the sponges.

The Conditions of the Depths.—Pressure.—The conditions which might be expected to affect animal life at great depths in the ocean are pressure, temperature, and the absence of light, involving apparently the absence of vegetable food. The conditions of pressure are certainly very peculiar. A man at the depth of a mile would bear upon his body a weight equal to about ten ordinary goods trains, engines and all, loaded with pig iron. We are apt to forget, however, that water is nearly incompressible, and that therefore the sea-water at the depth of a mile has scarcely an appreciably greater density than it has at the surface. At the depth of a mile, under a pressure of 159 atmospheres, sea-water, according to the formula given by Jamin, is compressed by the $\frac{1}{144}$ of its volume, and at twenty miles, supposing the law of the compressibility of water to continue the same, by only $\frac{1}{7}$ of its volume; that is to say, the volume at that depth will be still $\frac{6}{7}$ of the volume of the same weight of water at the surface. Substances, also, permeated and uniformly supported within and without by the water, are, so far as their physical conditions, freedom of motion, &c., are concerned, in no way affected by the pressure. We sometimes rise in the morning and find, from a fall of an inch in the barometer, that we have been gradually and quietly relieved during the night of half a ton weight; yet we feel it only by a slight lassitude, from its requiring rather more muscular exertion to move our bodies in the rarer medium. There is no reason to believe that water contains less air at great depths than at the surface; it is even possible, owing to the great compressibility of air, that it may contain more. As the increase in the density of the water at the depths at which we dredged was scarcely perceptible, we

found no inconvenience at all from the pressure, except in one particular. The strong tarred hemp rope which we used belonged to the upper world, and, like all such terrestrial fabrics, it contained a large quantity of air. Down in the depths every particle of the air was squeezed out, and the fibres of the hemp and the tar were crushed together, so that the rope looked and cut almost like a stick of liquorice. I fear the rope became rather brittle; for it snapped once or twice without apparent cause, and we lost our dredges. This may turn out to be a serious difficulty in the way of dredging in much greater depths.

Temperature.—There has been up to the present time a strange misconception as to the temperature of the ocean—a misconception all the more singular as it is a point easy of approximate determination, and to which a good deal of attention has been directed. In all the leading text-books on physical geography we have the reiterated statement that at a certain depth the ocean has a uniform temperature of 39° F., that the ocean is, therefore, divided into three regions, bounded by the two isotherms of 39° F., that north and south of these lines the mean temperature of the surface is lower than that of the depths, while in the zone between them it is higher. Had the sea been fresh, it would have been perfectly intelligible that the water beyond the influence of currents and of direct solar heat should have maintained the temperature of its point of greatest density; but it has long been well known, from the experiments of M. Despretz and others, that sea-water contracts steadily down to its freezing-point, which is about 28° F. when agitated, and as low as 25° F. when perfectly still.

Though I had often wondered what could be the cause, I believed in this permanent temperature of the sea thoroughly, and even suggested the particular course for our cruise, because it nearly coincided with the isotherm of 40° F., expecting that we should be able, within a few hundred feet of the surface, to eliminate the question of heat entirely from our calculations. To our very great surprise, the thermometers, two of which were sent down on the lead-line, the day after we left Stornoway, to a depth of 500 fathoms, registered a minimum temperature of 49°, ten degrees *above* the "permanent point." We were at first inclined to mistrust the observation; but we took the same temperature at nearly the same spot on our return, when we were quite prepared to recognize it as the almost constant temperature of the warm or Gulf-stream area of the region. Some days later, on leaving Thorshaven and proceeding south-eastwards, we sounded and took temperatures

with three registering thermometers, in 510 fathoms, in lat. 60° 45′ N. and long. 4° 19′ W., when the three thermometers, which were within about 2° of one another, gave a mean result of 32°·2, almost exactly the freezing-point of fresh water, and more than 7° *below* the "permanent point." Many subsequent observations enabled us to determine that a cold area, where the thermometer ranged about 32° F., at a depth of from 400 to 500 fathoms, extended between lat. 60° and 61° N., and long. 4° 30′ and 7° 30′ W., and that an area stretched north-westward, westward, and south-westward of this cold area, in which the thermometer, to the depth of 650 fathoms, was very permanent at 47·°5 to 49° F. This is an unexpected result, but it is undoubtedly in the main correct. The soundings were made with the greatest care and with the best instruments, and several thermometers by different makers were employed on every occasion, every precaution being taken to avoid error.

Since the Gulf-stream, to which we attribute the warmth of the warm area, appears to affect the temperature of the sea to the very bottom, it is easy enough to conceive that the temperature may be permanent over a considerable region at 49°; but it is not so evident why the temperature of the cold area should remain permanently two or three degrees above the freezing-point of salt water. Experiments are yet wanting to determine the influence of great pressure upon the freezing-point of water; but it is possible that the freezing-point may be the actual limit, and that the Sixes thermometers, which have large bulbs, register a degree or two too high, under the enormous pressure of 100 atmospheres. If this be the case, the condition of things must be very peculiar. Minute spicules of light fresh ice must be continually forming, and rushing upwards to be melted in the first shell of water whose temperature is above the freezing-point. The animal inhabitants must live in perpetual winter—a winter not more severe, however, than that which is bravely borne by the myriads of Limacinas and Clios which sport in every crack in the ice-fields of the Arctic Sea.

Nutrition.—The question of the mode of nutrition and life of animals at these great depths is a very singular one. The practical distinction between plants and animals is that plants prepare the food of animals by decomposing certain inorganic substances which animals cannot use as food, and recombining their elements into organic compounds upon which animals can feed. This process, however, is constantly effected under the influence of light; there is little or no light in the depths, and naturally there are no plants. But the bottom of the sea is a mass of animal life; on what do these animals feed?

The answer seems to be sufficiently simple: nearly all the animals (practically *all* the animals, for the small number of higher forms feed upon these) belong to one subkingdom, the Protozoa, whose distinctive character is that they have no special organs of nutrition, but that they absorb nourishment through the whole surface of their jelly-like bodies. Most of these animals secrete exquisitely formed skeletons, sometimes of lime, sometimes of silica. There is no doubt that they extract both of these substances from the sea-water, although silica often exists there in quantity so small as to elude detection by chemical tests. All sea-water contains a certain quantity of organic matter in solution. Its sources are obvious. All rivers contain a large quantity; every shore is surrounded by a fringe which averages about a mile in width of olive and red sea-weeds; in the middle of the Atlantic there is a marine meadow, the Sargasso Sea, extending over three millions of square miles; the sea is full of animals which are constantly dying and decaying; and the water of the Gulf-stream especially courses round coasts where the supply of organic matter is enormous. It is therefore quite intelligible that a world of animals should live in these dark abysses; but it is a necessary condition that they should chiefly belong to a class capable of being supported by absorption, through the surface, of matter in solution, developing but little heat, and incurring a very small amount of waste by any manifestation of vital activity. According to this view, it seems highly probable that at all periods of the earth's history some form of the Protozoa, Rhizopods, Sponges, or both, predominated greatly over all other forms of animal life in the depths of the warmer regions of the sea—whether spreading, compact, and reef-like, as the Laurentian and Palæozoic *Eozoon*, or in the form of myriads of separate organisms, as the *Globigerinæ* and Ventriculites of the chalk. The Rhizopods, like the Corals of a shallower zone, form huge accumulations of carbonate of lime; and it is probably to their agency that we must refer most of those great bands of limestone which have resisted time and change, and which come in here and there with their rich imbedded lettering, to mark, like milestones, the progress of the passing ages.

XIV.—*Observations on the Calamites and Asterophyllites.* By M. Grand'Eury*.

Calamites.—The Calamites were regarded by the older naturalists as reeds, and owed their name to that supposition.

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus March 22, 1869, tome lxviii. pp. 705–709.

M. Brongniart was one of the first to approximate them to the Equisetaceæ, guided by the analogy of their most important external characters.

Dr. Petzholdt, and subsequently M. Richter, thought that decisive evidence in favour of this approximation was to be found in the internal structure of these stems; but the differences in their observations still left doubts on the subject, and the question thus remained enveloped in much obscurity.

The investigation that I have made of upright Calamites, which are very common in the Coal-measures of the Loire, will, I think, enable me to answer it in a satisfactory manner, and to give a more complete definition of the Calamites.

In the first place, the frequent presence of more or less complete septa at the joints is a perfect proof that these stems were fistular.

Again, in nearly all of them we find, generally surrounding the nucleus, a sort of internal epidermis, of cellular nature, which is smooth or sometimes marked on the outside by lines projecting opposite to the inner crests of the bark. This epidermis, which was also found by Dr. Petzholdt in Calamites, cannot have detached itself here from the inner surface of the coaly (*houillifiée*) envelope, of which it does not possess the form, and from which it is naturally separated, when it seems to have retained its relative position, by from half to two millimetres. Moreover it is connected with the septa, and forms with them one and the same system, which seems to unite with the bark, where it is contracted at the level of the articulations, by a sort of internal denticulations. There is also, between the coaly envelope and the inner epidermis, a thin structureless zone, which has evidently been occupied by tissue now destroyed. This tissue, which must have been lax and perhaps lacunar, as it is always completely destroyed, certainly corresponds to the vascular tissue of the Calamites, and may probably have represented in them the circle of lacunæ essential to the *Equiseta* (Duval-Jouve).

From this it seems to me that we may define the true Calamites as follows:—

Stems articulated, fistular, and septate, of which the outer part, which is comparatively thin, is formed by three concentric zones, namely:—1, an exterior cortical layer, now converted into coal; 2, a thin subjacent zone of vascular tissue, now invariably destroyed; 3, a sort of inner lining epidermis, which is carbonified.

Cortical envelope marked interiorly with regular flutings, interrupted and alternate at the articulations. Inner epidermis smooth or scarcely striated. Vascular cylinder thin, smooth within as having been covered by the inner epidermis, and adorned on the

outside with ribs, which are interrupted and strictly alternate at the articulations, having been in contact with the cortical envelope, which has faithfully preserved its form.

Outer surface of the bark more feebly fluted and articulated than the inner surface, of which it forms a reflection weakened in proportion to the thickness of the bark. Opposite to the articulations branch-scars are present, but not constantly; and there is no evident trace of the insertion of leaves.

In place of these there are sometimes, but not always, some small tubercular swellings, which, originating in the interior, only appear distinctly on the outside when the bark is thin; but as there is at the surface no scar indicated by the absence of the epidermis and by vascular passages, and defined and bounded by a precise line, such as is seen in most stems of the coal-measures, and also on account of their position at the summit of the ribs, they are only the representatives of the rudimentary teeth of an aborted sheath. So that the Calamites were destitute both of leaves and sheaths.

These chief features of organization which the Calamites possess in common with the *Equiseta*, are associated with characters of subterranean vegetation likewise so capable of identification with those of these same existing plants, that they must be regarded as forming an extinct genus of the family Equisetaceæ.

Thus having been able to follow the removal of the floor of a coal-bed in which *Calamites Suckowi*, Brong., is very abundant in an upright position, I had the good fortune to see that vertical stems of this species emit at their articulations thin running rhizomes, which, after becoming elongated to from 0·50 to 1 metre, swell suddenly and rise up as ascending stems—that these, again, in their turn emit fresh definite rhizomes, but only from the elbow which they form in ascending, and so on, producing a succession of stems, which is not without analogy to what we see in *Equisetum variegatum*. It is even probable (but this I have not yet ascertained) that the vertical mother stem which gives rise to so many suckers, derives its own origin from a deep-seated rhizome. If this were the case, we should have, in these numerous groups of rhizomes springing one from the other, as it were the witnesses of an ancient marsh occupied by a species of Calamite, which, just like *Equisetum limosum*, would have spread over a great space of inundated land. However this may be, the mother stem, the definite rhizomes, and only the base of the ascending stems are furnished with simple or ramose rootlets.

As regards the other isolated Calamites of the fossil forests

of Saint-Etienne, in the casts of which we find the same traces of structure, they are straight, possess a few rootlets at the base, and appear to have an individual existence. But this individuality is perhaps more apparent than real; for their distribution in the fossil forests, and the agglomeration of the same stems in certain places, are favourable to the supposition that they sprang from slender indefinite rhizomes, of which nothing has remained for our investigation.

Lastly, there is nothing, even to the approximation of the articulations at the origin of the stems and rhizomes, that is not imitated by the living *Equiseta.*

Calamophyllites and Asterophyllites.—Nothing is at present settled as to the nature of the stems of which the arborescent Asterophyllites are the caducous branches, although a certain number of stems bearing branches of Asterophyllites have already been found. The uncertainty in which we are upon this subject is such that these branches have been ascribed both to the Calamites belonging to the group of vascular Cryptogamia and to the *Calamodendra* belonging to the Gymnosperms, their inflorescence, described as *Volkmannia,* being still incapable of solving the question, because the organized dust discovered in the sacs borne by some of them in the axils of their bracteal leaves might equally well consist of spores or of pollen. However, it is most desirable now to ascertain the real connexion of organs which are invariably dissociated, mutilated, and so profoundly altered.

I believe I have sufficient data to prove that the greater part of the Asterophyllites are not branches of Calamites, but of other stems, which even depart widely from them in their characters, and to which I give the name of *Calamophyllites.*

It would appear that the Asterophyllites cannot be the branches of the true Calamites, not only because these branches would be furnished with leaves whilst the stems are destitute of them, which has nothing absolutely impossible in it, but because, besides not being so well grooved and articulated, they have their leaves attached above the lines of articulation, and, what is far more significant, their secondary branches inserted in the axil of the leafy whorls, and not below them, as would be the case if they had the organization of the true Calamites.

Moreover all the branches which I have seen issuing from true Calamites have exactly all the essential characters of the latter, and have neither leaves nor any indications of having possessed them. I have frequently found, mixed together, considerable quantities of branches of various sizes, constructed

at their articulations exactly like certain Calamites—so much so that all, even to the slenderest, appear to have emitted whorls of branches, whilst the branches of *Asterophyllites* only gave origin to distichous ramifications, and this, moreover, unsymmetrically. I have even seen the apex of a Calamite with its articulated branch-shoots as destitute of leaves as the stem.

On the other hand, I have ascertained, from several most instructive specimens, that the stems which are surrounded and surmounted by branches of Asterophyllites resemble the latter in all points, have leaves or leaf-scars, and in general only a vague and distant resemblance to the Calamites.

From this, therefore, we may conclude that the arborescent Asterophyllites sprang, not from Calamites, but from leaf-bearing stems organized like themselves.

These stems are not rare, and I have already found several of them. *Hippurites longifolius*, Lindl., is evidently a fine and complete example, and *Calamites Goepperti*, Ettingsh., is another, deprived of its leaves. They form a group which may be characterized as follows:—

Stems articulate, very certainly hollow and septate, of herbaceous nature, not always regularly striate. Leaves caducous, attached to a cincture of articular protuberances situated above the line of articulation, and not in relation to the striæ or indistinct ribs situated below, erect or raised, linear, flat; they appear smooth or traversed by few and distinct or by numerous, very fine, equal and parallel nervures. Caducous branches of Asterophyllites inserted all round and essentially above the articulations, in the axil of the leafy whorls, leaving by their fall large discoidal scars situated completely above, and not opposite to the articulations.

I do not wish to assert here that all the arborescent Asterophyllites originate from similar stems, although their leaves are generally striated by fine, equal and parallel nervures. I have even good reasons for the opposite opinion; for I know of stems, analogous to *Calamites varians*, Sternb., which appear to have had leaves inserted at the end of the ribs; and I have seen an Asterophyllite which was to be referred to large stems invaginated at their articulations by leaves joined together at the base, as in the genus *Phyllotheca*, and to which, on account of this peculiarity, I give the name of *Phyllotheca*

XV.—*Observations on the Ancient Fauna of the Mascarene Islands.* By M. Alphonse Milne-Edwards*.

Among the bones collected in the Island of Mauritius, in the Mare aux Songes, side by side with the remains of the dodo and of the gigantic coot, which I have already had the honour of mentioning to the Academy, I noticed a lower jaw which appeared to me to be derived from a bird entirely unknown at the present day, and belonging to the group of the Grallæ, together with some parts of the foot indicating the former existence of a new generic type allied to *Ocydromus*. I inclined to believe that all these bones belonged to the same extinct species; but I hesitated about pronouncing an opinion upon this subject, when some facts of another kind lately ascertained at Vienna by M. von Frauenfeld removed all my doubts, and enabled me to arrive at more complete results.

In the collection of paintings upon vellum made chiefly in the reign of Rodolph II. by Hoefnagel, a Dutch artist, and which now belongs to the private library of the Emperor of Austria, that naturalist found two coloured drawings, reproductions of which he hastened to publish. One of these pictures represents the dodo, the other a very remarkable bird, which in its aspect somewhat resembles the *Apteryx*, and which appears to be the species mentioned by F. Cauche, under the name of the *Poule rouge au bec de Bécasse*, as living in the Island of Mauritius at the beginning of the seventeenth century. In the memoir which accompanies these plates, M. von Frauenfeld has endeavoured to settle the place which this bird should occupy in our zoological classification; but the characters displayed by the figure which he had before him could not enable him to arrive at a complete solution of this question, and he was obliged to confine himself to indicating the features of resemblance of the *Poule rouge au bec de Bécasse* on the one hand to the Gallinaceæ, on another to the Rails, and in the third place to the *Apteryx*; finally, he gives it the generic name of *Aphanapteryx*—a designation which seems to indicate that it is with the last that he found the greatest analogy.

I easily convinced myself that the bones of which I have just spoken as having been found in the Mauritius, and the examination of which had been kindly intrusted to me by MM. Newton, all belonged to the *Aphanapteryx*; and the anatomical peculiarities presented by these fossils enable me

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' April 12, 1869, tome lxviii. pp. 856–859.

to establish with strict precision the natural affinities of this lost type, and to assign it its true zoological position.

The *Aphanapteryx* or *Poule rouge au bec de Bécasse* is not a gallinaceous bird, nor does it belong to the natural group of which the *Apteryx* is now the only living representative; it is not a Rail properly so called, but it must take its place side by side with the Australian genus *Ocydromus*.

The lower mandible, in its general form, resembles that of the curlews, ibises, and certain passerine birds, such as *Promerops*, *Xiphorhynchus*, *Falculia*, and *Dendrocolaptes*; but the osteological characters furnished by the arrangement of the articular surface, and by the form of what I have denominated the *postdentary* fissure, do not allow us to regard this bone as belonging to any passerine or gallinaceous bird, or to any of the genera of Grallæ which I have just mentioned; nor do its characters remove it less from *Apteryx*; and to find a more complete resemblance we must compare this beak with that of *Ocydromus*.

In order to avoid making this statement too long, I must suppress here all descriptive details, which will be found in the memoir which I deposit upon the bureau of the Academy. I shall confine myself to adding that if, from the structure of this part of the head, we seek to explain the habits and diet of the bird to which it belongs, we shall see that the absence, or at least the slight development, of the foramina and little channels for the passage of nerves and vessels will not allow us to ascribe to it the habits of the ibises, curlews, godwits, or snipes. This pointed beak of very dense tissue somewhat resembles that of *Porphyrio* and *Ocydromus*, and reminds us still more of the conformation of the mandibles in the oyster-catchers; it seems to be perfectly adapted for breaking the shells and resisting envelopes of the animals on which the *Aphanapteryx* probably fed.

It is sufficient to glance at the metatarsus to be convinced that it is derived from a bird admirably constructed for walking; it is perfectly balanced, and, without being too massive, is very robust. Its characters indicate most clearly that it cannot be derived from a bird of prey or from a passerine or natatory bird. It has belonged to a walking bird, and in its general form as well as in several of its characters it approaches that of the Gallinaceæ; nevertheless it is impossible to refer it to that group. In fact I have ascertained that in all the Gallinaceæ, without exception, the flexor muscle belonging to the hind toe is inserted upon a deeply hollowed surface of the posterior face of the heel bounded by very prominent crests. In nearly all the birds of this group, even in those

which are destitute of spurs, there also exists a bony crest or stay which unites the postero-interior margin of the bone with the heel. These characters are entirely wanting in the fossil found in the Mare aux Songes. If we compare this metatarsus with that of the waders, we find that its relative proportions, as well as its anatomical peculiarities, separate it from that of the Ciconidæ, Gruidæ, Ardeidæ, Totanidæ, and Bustards; but we find in it great analogies with the foot-bone of certain representatives of the family Rallidæ, although it differs much from the typical form in this group. But it is to be remarked that in proportion as these birds are constructed for walking, their metatarsus acquires more and more the distinctive characters of that of *Aphanapteryx*: thus in passing successively from the Coots to the Rails, to *Tribonyx* and to *Ocydromus*, we insensibly arrive at the form which is presented by our fossil, and which, at the first glance, would appear to be quite special.

In the same deposit with this lower mandible and tarsometatarsal several tibiæ have been discovered, which seem to be referable to the same bird; for the study of the peculiarities which they present leads to the same result as the examination that I have just made of the osteological characters of the foot-bone.

All these anatomical facts prove, it seems to me, that *Aphanapteryx* forms a peculiar generic division side by side with *Ocydromus*. It must be regarded as one of those transition forms which are so remarkable in the animal kingdom; it is a rail, the organization of which has adapted itself to an essentially terrestrial existence.

We see, from the figure the knowledge of which we owe to M. von Frauenfeld, that the feathers of this bird were too light and possessed too little resistance to have been capable of serving it for flight, and moreover the wings were rudimentary; the feet, on the contrary, presented considerable strength, but they are not very long, and the toes are less elongated than is usual in this family. This would lead us to think that this species had less aquatic habits than most of the Rallidæ; nevertheless the [hind] toe is very long, as in birds which frequent muddy places where the soil has but little consistency, whilst among the true runners it disappears more or less completely, in order to diminish the weight at the extremity of the arm of the lever formed by the foot.

The recent destruction of the *Aphanapteryx* can only be ascribed to man or to the animals which he brought in his train; and it is interesting to remark that this species, which inhabited the Mascarene Islands at a period so nearly ap-

proaching our own days, is a new example fitted to demonstrate, on the one hand, the existence of close relationships between the fauna of these isolated lands and the zoological population of the Australasian region, and, on the other, the complete separation of this fauna from that of the great African continent.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 18, 1868.—Lieut.-General Sabine, President, in the Chair.

"Note on the Bloodvessel-system of the Retina of the Hedgehog." By J. W. Hulke, F.R.S., Assistant-Surgeon to the Middlesex Hospital and the Royal London Ophthalmic Hospital.

The distribution of the retinal blood-vessels in this common British Insectivore is so remarkable that I deem it worthy of a separate notice: *only capillaries enter the retina.*

The vasa centralia pierce the optic nerve in the sclerotic canal, and, passing forwards through the lamina cribrosa, divide, at the bottom of a relatively large and deep pit in the centre of the intraocular disk of the nerve, into a variable number of primary branches, from three to six. These primary divisions quickly subdivide, furnishing many large arteries and veins, which, radiating on all sides from the nerve-entrance towards the ora retinæ, appear to the observer's unaided eye as strongly projecting ridges upon the inner surface of the retina. When vertical sections parallel to and across the direction of these ridges are examined with a quarter-inch objective, we immediately perceive that the arteries and veins lie, throughout their entire course, upon the inner surface of the membrana limitans interna retinæ, between this and the membrana hyaloidea of the vitreous humour, and that only capillaries penetrate the retina itself.

In sections of the retina across the larger vessels the membrana limitans may be seen as a clean distinctly unbroken line passing over the divided vessels, with which it does not appear to have any direct structural connexion. The relation of the hyaloidea to the large vessels seems to be more intimate; but its exact nature can be less certainly demonstrated, owing to the extreme tenuity of this membrane. In my best sections I saw the hyaloidea also crossing the large vessels, as does the limitans; but excessively delicate extensions of the hyaloidea appeared to me to lose themselves upon the vessels.

The capillaries, shortly after their origin, bend outwards away from the large vessels, and, piercing the retina vertically to its stratification in a direction more or less radial from the centre of the globe, and branching dichotomously in the granular and inner granule-layers, they form loops, the outermost of which reach the inter-granule layer. As they enter the retina, the membrana limitans

interna is prolonged upon the capillaries in the form of a sheath, which is wide and funnel-like at first, but soon embraces the vessels so closely as to become indistinguishable from their proper wall; so that, notwithstanding the existence of a sheath, there is no perivascular space about the retinal capillaries, such as His has described in the brain or spinal cord, and has stated to occur in the retina and elsewhere.

In all other mammals, except the hedgehog, as far as my present knowledge extends, the arteries, veins, and capillaries lie *in* the retina. In fish, amphibia, reptiles, and birds, however, as H. Müller and others (myself as regards amphibia and reptiles) have shown, the retina is absolutely nonvascular, the absence of proper retinal blood-vessels being compensated for in fish, amphibia, and some reptiles by the vascular net which in these animals channels the hyaloidea, and by the highly vascular pecten present in other reptiles and in birds. Thus it is possible to divide vertebrates into two classes, according as their retina is vascular or non-vascular; and these classes would be connected by the hedgehog, the larger branches of whose vasa centralia, lying upon the membrana limitans in intimate relation with the hyaloidea, represent the equivalent vessels of the hyaloid system, which forms so exquisite a microscopic object in the frog; whilst the capillary vessels channelling the retinal tissues occupy the same position which they do in most mammalia.

MISCELLANEOUS.

On the Origin of the Name "Penguin."

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—More than ten years ago it occurred to me that the name "Penguin" or "Pengwin," applied to certain sea-fowl which are unable to fly, was a corruption of "pen-wing" or "pin-wing," meaning a bird that had apparently undergone the operation of pinioning or "pin-winging," as it is, in at least one part of England, commonly called. Lately Mr. Henry Reeks, who has been successfully pursuing the investigation of natural history in Newfoundland, has kindly informed me that in that country the name "Penguin" used there to signify the *Alca impennis* of Linnæus, is invariably pronounced "Pen-wing;" and this fact seems to confirm the supposition I had formerly entertained. I shall be greatly obliged to you by allowing me to mention in your pages this suggestion, which, so far as I am aware, has not been before published, especially as neither of the only two derivations of the name which I have seen assigned—the first from the Latin *pinguedo* (fatness), the second from the Welsh *pen gwyn* (white head)—appears to me at all probable.

I am, Gentlemen,
Your obedient Servant,

Bloxworth, July 22, 1869. Alfred Newton.

On the Structure of the Flower of the Gramineæ, *the Functions of the Organs of which it is composed, and the Phenomena which accompany the act of Fecundation.* By M. Bidard.

The flower of the Gramineæ is formed of a two-valved perigonium (glumella). The outer valve, which is always the larger, is in the form of a keel; its texture is coarse and parchment-like; and it embraces the inner valve with its margins all round. The inner valve is almost flat externally; its tissue is slight and transparent; at its margins it is folded inwards so as to form two screens, closed above and separated below. On its sides the inner valve is furnished with very numerous hairs.

The arrangement of these two valves is such that they form by their juxtaposition a completely closed chamber, the closure of which is rendered still more perfect by the hairs of the inner valve. Under such circumstances no foreign body can penetrate into the interior. In this chamber are enclosed the ovary and the organs of fecundation.

The stamens are three in number, and they occupy two-thirds of the space formed by the union of the two valves. Two of the stamens are placed one on each side of the ovary, and the third is opposite to it. The filaments do not exceed the ovary in length; at the base of the filaments, in front of the ovary, two glands (glumellulæ of botanists), varying in form according to the genus, occur in all the Gramineæ.

The ovary is surmounted by two stigmata, each of which is formed by a principal canal, upon which small canals are inserted laterally, having narrow tubes open at their extremity.

Phenomena of Fecundation.—The phenomena of fecundation occur when the organs of the flower have attained their full development. In the Gramineæ fecundation is instantaneous. It is manifested as follows:—

The anthers open laterally, become animated by a movement of torsion, and let fall a shower of pollen upon the stigma, which is spread out like a fan; at this moment the filaments become rapidly elongated; and by means of this elongation and of their movement of torsion the stamens separate the valves, force a passage, and hang down outside the flower. They are then almost empty. At this period the agriculturist says, "The corn is in flower;" but this is an error: the fecundation is completed.

The filaments of the stamens are not arranged in a spiral form, nor are they folded upon themselves. To effect their elongation they require perfectly prepared material; and this they find in the two glands placed at the base of the ovary: these contain a thick juice, which may be extracted by pricking them with a needle. The glands serve so well for the alimentation of the filaments, that they are emptied when the elongation takes place.

The pollen of the Gramineæ possesses no trace of a pollinic tube, nor could I in any case observe an ejection of fovilla. When the pollen falls upon the stigma, it attaches itself to the narrow tubes

which perforate the latter. These tubes, which are open at the extremity, play the part of suckers, which pump in the fovilla and transmit it through the canals to the ovary. After fecundation, the perforated pollen becomes dried up, whilst the stigma becomes folded upon itself and withers.

Consequently in the Gramineæ two principal phenomena occur, which are witnessed only in this family:—

1. The elongation and expulsion of the filaments of the stamens.
2. Fecundation by the perforation of the pollen.

These do not occur without reason.

The seed, the result of fecundation, must occupy when perfectly developed, the whole chamber formed by the union of the two valves. Now the stamens occupy two-thirds of this space, and by their volume they would obstruct the growth of the seed: they must be expelled; and hence the elongation of the filaments, and the existence and the utility of the alimentary glands.

As the fecundation is instantaneous, it is necessary that the fovilla should instantaneously penetrate to the ovary through the stigma, the existence of which only lasts during the moment of fecundation; hence the structure of the stigma, and the phenomenon of the perforation of the pollen.

All the facts that I have just indicated may be very easily observed in our cereals and the grasses of our meadows. To see the details of the fecundation, it is only necessary to split the outer valve longitudinally; by separating the two parts of this valve, we expose the organs of fecundation enclosed in the two curtains of the inner valve, and the warmth of the breath or a ray of the sun is sufficient to induce the phenomenon of fecundation.

The natural hybridization of the Gramineæ is impossible, from the exact closure of the space or chamber containing the organs of fecundation.—*Comptes Rendus*, June 21, 1869, tome lxviii. p. 1486.

On a Tree-Frog in New Granada which secretes a Poison employed by the Indians to poison their Arrows. By J. Escobar.

This tree-frog appears to belong to the species called *Phyllobates melanorhinus*. It is known in the country by the names of *Ranilla roja* or *rojiça*. During life it is of a red tint shaded with Naples yellow, and consequently rather yellowish red, like certain oranges, the colour of which approaches that of the citron. The yellow predominates when the animal has been some time in alcohol. There are two varieties—one in which the belly is black, and another in which it is of the same colour as the upper parts.

The poison is furnished by the dorsal region. It does not appear to possess its properties completely unless it is collected at the moment when the animal, still living, secretes it. To cause its secretion, they introduce into the mouth of the frog a small wooden spatula, and, taking great precautions in order not to produce injuries which would cause death too rapidly, push it in so as to cause great suffering, under the influence of which the whole upper surface of the

body becomes covered with a white, milky, and viscous liquid. This is the poison, with which the tips of the arrows are imbued as quickly as possible. Sometimes they obtain a greater quantity of this substance, if the animal has not succumbed under the first operation, by introducing a bodkin into one of the abdominal limbs, which induces a secretion of the same kind upon its surface. At other times, again, the same result is attained by exposing the frog to the moderate heat and the smoke of a clear fire*.

This poison can cause the death of large animals, such as the jaguar. It is likewise fatal to man.

Experiments tried upon animals seem to prove, like those made with curare, that the toxical action affects the organs of movement, and not those of sensibility. The drowsiness and sleep which precede the death of animals poisoned by the venom of toads were not observed.—*Comptes Rendus*, June 21, 1869, tome lxviii. p. 1488.

An Hermaphrodite Nemertean from the Mediterranean. By A. F. Marion.

Prof. W. Keferstein lately described (Archiv für Naturgeschichte, 1868), under the name of *Borlasia hermaphroditica*, a curious monœcious species, of which he only observed a single individual, at St. Malo in August 1867. This unexpected discovery has hitherto remained an isolated fact.

In March of the present year I discovered, on the coast of Marseilles, a new hermaphrodite Nemertean, which I have since obtained several times, always in full gestation. This species belongs to the genus *Borlasia*; but it is distinct from the *B. hermaphroditica* of St. Malo, as is admitted by M. Keferstein himself, to whom I am happy to be able to dedicate it. *Borlasia Kefersteinii* lives at great depths, among the incrusted Algæ which usually shelter numerous Annelida of both the errant and sedentary forms.

Its body, which is very proteiform, attains a length of 15 millimetres when the animal is fully extended. It is covered with vibratile cilia, which are more numerous and longer in front round the aperture of the proboscis, and behind round the anal orifice. The head bears two pairs of eyes, furnished with a crystalline and a mass of black pigment. The proboscis is placed above the digestive tube, and seems sometimes to extend even to the lower extremity of the body. The anterior region of this organ is covered with tufts, which become interrupted and disappear a little below the stylus.

The male and female ovules are developed between the hepatic layer of the digestive tube and the walls of the body, in the usual manner. The female ovules, when completely developed, measure 0·317 millim., and consist of a vitelline membrane, a vitellus (which

* This last process has been indicated by M. Roulin as being employed by the Indians who wish to obtain from the Batrachians of the Choco the venom with which they poison their arrows (Revue des Deux Mondes, 1835, sér. 4. tome iv. p. 187).

is formed in the interior of the ovule), and a geminal vesicle of 0·09 millim. in diameter. The male ovules, the size of which is a little less than that of the female ova, are full of long filaments, which move briskly when isolated. These two sexual elements exist throughout nearly the whole length of the body, from the commencement of the digestive tube to near its extremity.—*Comptes Rendus*, July 5, 1869, tome lxix. p. 57.

Note on the Crustacea which live parasitically in Ascidia in the Mediterranean. By R. Buchholz.

The Crustacea living as parasites in the Ascidia have been very carefully studied on the shores of Sweden by M. Thorell, and on the French oceanic shore by M. Hesse. In the Mediterranean these parasites had not hitherto been noticed except cursorily. M. Buchholz has just carefully investigated ten species at Naples. Except a *Lichomolgus*, the whole belong to the family Notodelphyidæ, of which M. Thorell has described ten northern species. The genera of this family established by the Swedish naturalist (*Notodelphys*, *Doropygus*, *Botachus*, and *Ascidicola*) appear all to belong to the fauna of Naples, which includes in addition the genera *Notopterophorus*, *Gunentophorus*, and *Goniodelphys*. The last two are as yet exclusively Mediterranean.

The most remarkable peculiarity of the Notodelphyidæ consists in the exceptional form of the thorax in the females, which gives these Crustacea a very peculiar appearance. This region is modified by the extraordinary development of an incubatory cavity, which receives the eggs descending from the ovaries and preserves them until the complete development of the embryo. This cavity is produced by a transformation of the last thoracic segments (in general the last two) into a part projecting on the dorsal side—a part to which M. Thorell gives the name of the *matrical region*.

The movements of these little Crustacea have by no means the vivacity of those of the normal Copepoda. The action of their natatory feet is very slow, at least in the adults, and produces a simple creeping along the walls of the respiratory cavity of the Ascidia, rather than a true natation.

It is not easy to detect the mode of communication of the ovaries with the incubatory cavity. M. Buchholz, however, believes he has ascertained that in the genus *Goniodelphys* the ovaries open directly into this cavity; and he thinks, in opposition to M. Thorell, that this is the case also in the other genera. He is not much disposed to believe that the eggs quit the ovary and pass by the seminal receptacle before entering the incubatory cavity, as M. Thorell supposes to be the case in *Notodelphys*. The external sexual aperture by which the eggs quit the incubatory cavity is placed upon a little papilla, between the last thoracic segment and the dorsal surface of the abdomen, as has already been indicated by M. Thorell. This observer likewise describes a second sexual aperture on the ventral surface. The seminal receptacles are described by him as connected

by a narrow canal with this second aperture, close to which he has found spermatophores attached in a *Doropygus*. M. Buchholz has seen nothing of the kind; but the important observation of M. Thorell appears to have been unknown to him at the time of his own investigations. He saw the eggs quit the uterus by the dorsal aperture, and did not think of seeking any other sexual pore.

M. Buchholz figures and describes the larvæ of the Notodelphyidæ. These are Nauplius-forms very similar to those of the other Copepoda. This, however, was already well known from the researches of Mr. Allman and M. Thorell.—*Siebold & Kölliker's Zeitschrift*, xix. pp. 99–162; *Bibl. Univ.* xxxv. July 15, 1869, *Bull. Sci.* pp. 246–248.

On the Cæciliæ. By M. F. Leydig.

The little group of the *Cæciliæ* presents so many remarkable peculiarities from a zoological point of view, that the memoir of M. Leydig, although essentially histological, deserves the attention of zoologists. The investigations of that naturalist relate to two species, viz. *Cæcilia lumbricoidea*, Daud., and *C.* (*Siphonops*) *annulata*, Mikan.

The structure of the skin of the Cæciliæ, leaving out of consideration the scales which exist in some species, agrees with that of the Batrachia in general. The nature of the epidermis was, indeed, long misunderstood. Following Mikan, several authors regarded it only as a mucosity secreted by the cutaneous pores or even by the anus. This error recurs even in the fine memoir of Johannes Müller upon the anatomy of the Amphibia. Rathke was the first to recognize in this supposed mucosity a true epidermis. M. Leydig now actually finds this epidermis covered by a distinct homogeneous cuticle. This epidermic layer is reflected into the numerous excretory canals of the cutaneous glands.

The scales, first discovered by Schneider, have given rise to numerous discussions among naturalists, more especially because these organs are deficient in all other Batrachia. The difference of opinion arises from the fact that one species, *C. annulata*, according to the decisive observations of Bischoff, Rathke, and Leydig, is in reality completely destitute of scales. The histological examination of *C. lumbricoidea* has shown M. Leydig that the deeper layer of the scale is formed by a solid stratified connective tissue filled with stellate cells. Its upper surface is adorned with shining corpuscles, arranged in rather irregular concentric series. M. Mayer calls them globules, M. Mandl cells. They are in reality calcareous concretions. The skin of the *Cæciliæ* presents a laminated structure, already noticed by several authors. This structure is due to numerous cutaneous folds, in the thickness of which the glands are lodged. The scales are placed between these laminæ. They are, however, not free, but attached to the corium by a delicate connective tissue.

The eyes of the *Cæciliæ* deserve particular attention, on account of their rudimentary state. *Cæcilia annulata*, although living at a depth of several feet in the mud of the marshes, has nevertheless

very small ocular bulbs. These bulbs correspond to a transparent spot in the skin, and present all the essential parts of a normal eye. The spherical crystalline alone preserves an embryonic character. In fact it is formed, not, properly speaking, of fibres, but of cells, some of them rounded, others elongated into tubes. The muscles of the eye, to the number of four, are attached to the sclerotic. Harder's gland is comparatively very large.

If zoologists are right in assigning to *Cæcilia annulata* the character "oculi minuti," they go too far, on the other hand, when they say of *C. lumbricoidea* "oculi nulli;" they ought to content themselves with saying "oculi minutissimi." The eyes are, in fact, always present, although extremely reduced. M. Leydig could distinguish in them a sclerotic and a choroid, but no crystalline. Harder's gland is comparatively enormous, no doubt because it has not undergone reduction like the bulb of the eye. The same is probably the case in *Typhlops*. In these serpents with rudimentary eyes, indeed, M. Duvernoy indicates a lachrymal gland six times as large as the bulb.

M. Leydig has paid particular attention to the singular organ mentioned by authors, sometimes under the name of false nostril, sometimes under that of lachrymal fossa. By this is meant a cutaneous pore leading into a canal which is directed obliquely towards the eye. Johannes Müller detected in the interior of this canal, in various species, a tentacle or papilla of a tongue-like form. M. Leydig confirms the existence of this organ, and finds moreover that in *Cæcilia annulata* two tubes, closely adhering to each other, start from the wall of the cavity. These might be taken, at the first glance, for vessels; but this is not their nature. Their wall does not contain any muscular fibres, but is formed of a single histological element—namely, very fine fibres of connective nature. These tubes reunite at the opposite extremity, forming a loop. An analogous organ exists in *Cæcilia lumbricoidea*. The functions of this apparatus are in complete obscurity. One might be inclined to regard them as the organs of a special sense, comparable with the "mucus-canals" of fishes. Nevertheless the essential character of a sensorial organ, the existence of a peripheral nervous apparatus, appears to be wanting in it.

What we know at present of the structure, both internal and external, of the *Cæciliæ* tends to separate them from the scaly reptiles, and to approximate them to the Amphibia. We must, however, admit with M. Leydig that their organization presents an odd mixture of characters, of which one reminds us of fishes, another of the amphibia, and a third of the reptiles. M. Leydig thinks that this little order, now so restricted, is only the residue of a group of amphibia formerly developed in abundance, which detached itself from the fishes with the amphibia of the Carboniferous epoch (*Archegosaurus* &c.). The affinity of the *Cæciliæ* to the fishes is displayed, as is well known, in the structure of the bodies of their vertebræ, and in the nature of their scales and their arrangement in cutaneous sacs. The kidneys of these animals have also been com-

pared with those of fishes; but M. Leydig does not accept this assimilation. The kidneys, according to him, have the same structure in the *Cæciliæ* as in the other Amphibia, and even remind him of the organization of the kidneys of serpents. Moreover the affinity with the Ophidia does not depend solely upon the general form of the body, but also upon the dentition and upon the atrophy of one of the lungs.

The predominant affinities of the *Cæciliæ*, however, are incontestably with the Amphibia: in support of this we may cite the richly glandular skin, the structure of the hyoid bone, the double occipital condyle on the cranium, the rudimentary ribs, and the presence of branchiæ in the young. We may also mention the existence of lachrymal glands, which are entirely wanting in fishes. As to the "false nostril," we may regard it either as a homologue of the cephalic fossa of the Ophidia or as a special organ.—*Siebold & Kölliker's Zeitschrift*, xviii. pp. 575–596; *Bibl. Univ.* xxxv. July 15, 1869, *Bull. Sci.* pp. 243–246.

On the Spire of Voluta Thatcheri. By Prof. Frederick M'Coy.

Since the description and figure of *Voluta Thatcheri* (M'Coy) were published in the 'Annals' for January 1868, I have got some fine specimens from Wreck Reef, North-east Australia, showing the spire to be rather slender, obtusely pointed, and composed of whorls, the two lower of which have nine or ten conical spines in a whorl, and those nearer the apex have a corresponding number of longitudinal ridges. The transverse rows of blotches are more red than in the first dead specimen, and the space between them netted with a paler orange pattern defining irregular trigonal white blotches.

I may also mention that I have likewise obtained specimens of *Voluta canaliculata*, described in the last Number of the 'Annals' (p. 34), from the same locality (Wreck Reef), with the colour more perfect and showing the lineations.

Melbourne, May 21, 1869.

On two new Species of Gyrodus. By Sir Philip de Malpas Grey Egerton, Bart., M.P., F.R.S., V.P.G.S.

The author remarked upon the characters of the genus *Gyrodus*, of which he described two new species, namely, *G. Goweri*, from a deposit of Oolitic age on the east coast of Sutherland, having the scales covered with a somewhat reticulated raised pattern, interspersed with granules; and *G. coccoderma*, from the Kimmeridge Clay of Kimmeridge, having the scales adorned with a multitude of symmetrical granules, which show no tendency to coalesce. The author also described a vomer of *Sphærodus gigas*, bearing teeth of the form usual in that genus, and remarked that this specimen established the validity of the genus *Sphærodus*.—*Proc. Geol. Soc.* June 23, 1869.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 21. SEPTEMBER 1869.

XVI.—*Notes on the Fertilization of Orchids.* By Charles Darwin, M.A., F.R.S., &c.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

Having drawn up some notes for a French translation of my work 'On the various contrivances by which British and Foreign Orchids are Fertilized by Insects' (1862), it has appeared to me that these notes would be worth publishing in English. I have thus been able to bring up the literature of the subject to the present day, by giving references to, together with very brief abstracts of, all the papers published since my work appeared. These papers contain, on the one hand, corrections of some serious errors into which I had fallen, and, on the other hand, confirmations of many of my statements. I have also been able to add, from my own observations and those of others, a few new facts of interest. A heading is given to each note, which will show the nature of the correction or addition, without any reference to my book; but I have added in a parenthesis the page to which the note ought to be appended.

Gentlemen,
Your obedient Servant,
Charles Darwin.

Down, Beckenham, Kent.
July 23, 1869.

Orchis or *Anacamptis pyramidalis* (p. 20).—The late Prof. Treviranus has confirmed (Botanische Zeitung, 1863, p. 241) my observations on this remarkable species; but he differs from me in one or two minor points.

On the kinds of Insects which habitually visit and fertilise some of the common British species of Orchis (p. 35).—I believe

that it may be safely predicated that orchids with very long nectaries, such as the *Anacamptis*, *Gymnadenia*, and *Platanthera*, are habitually fertilized by Lepidoptera, whilst those with only moderately long nectaries are fertilized by bees and Diptera—in short, that the length of the nectary is correlated with that of the proboscis of the insect which visits the plant. I have now seen *Orchis morio* fertilized by various kinds of bees, namely:—by the hive-bee (*Apis mellifica*), to some of which from ten to sixteen pollen-masses were attached; by *Bombus muscorum*, with several pollen-masses attached to the bare surface close above the mandibles; by *Eucera longicornis*, with eleven pollen-masses attached to its head; and by *Osmia rufa*. These bees, and the other Hymenoptera mentioned throughout these notes, have been named for me by our highest authority, Mr. Frederick Smith, of the British Museum. The Diptera have been named by Mr. F. Walker, of the same establishment. In Northern Germany, Dr. H. Müller of Lippstadt found pollen-masses of *Orchis morio* attached to *Bombus silvarum*, *lapidarius*, *confusus*, and *pratorum*. The same excellent observer found the pollen-masses of *Orchis latifolia* attached to a *Bombus*; but this orchis is also frequented by Diptera. A friend watched for me *Orchis mascula*, and saw several flowers visited by a *Bombus*, apparently *B. muscorum*; but it is surprising how seldom any insect can be seen visiting this common species. With respect to *Orchis maculata*, my son, Mr. George Darwin, has clearly made out the manner of its fertilization. He saw many specimens of a fly (*Empis livida*) inserting their proboscides into the nectary; and subsequently I saw the same occurrence. He brought home six specimens of this *Empis*, with pollinia attached to their spherical eyes, on a level with the bases of the antennæ. The pollinia had undergone the movement of depression, and stood a little above and parallel to the proboscis: hence they were in a position excellently adapted to strike the stigma. Six pollinia were thus attached to one specimen, and three to another. My son also saw another and smaller species (*Empis pennipes*) inserting its proboscis into the nectary; but this species did not act so well or so regularly as the other in fertilizing the flowers. One specimen of this latter *Empis* had five pollinia, and a second had three pollinia, attached to the dorsal surface of the convex thorax.

On nectar being secreted and contained between the outer and inner membranes of the nectary in several species of Orchis (p. 51).—I have repeated my observations on the nectaries of some of our common species, and especially on those of *Orchis morio*, *at the time when various bees were continually visiting*

the flowers; but I could never see the minutest drop of nectar within the nectary. Each bee remained a considerable time with its proboscis in constant movement whilst inserted into the nectary. I observed the same fact with *Empis* in the case of *Orchis maculata*; and in this orchis I could occasionally detect minute brown specks, where punctures had been made. Hence the view suggested by me that insects puncture the inner lining of the nectary and suck the fluid contained between the two coats may be safely accepted. I have said in my work that this hypothesis was a bold one, as no instance was known of Lepidoptera penetrating with their delicate proboscides any membrane; but I now hear from Mr. R. Trimen that at the Cape of Good Hope moths and butterflies do much injury to peaches and plums by penetrating the skin, in parts which have not been in the least broken.

Since the appearance of my work, the following observations have been published on other species of Orchis *and on certain allied forms* (p. 53).—Mr. J. Traherne Moggridge has given (Journ. Linn. Soc. vol. viii. Botany, 1865, p. 256) a very interesting account of the structure and manner of fertilization of *Orchis* or *Aceras longibracteata.* Both pollinia, as in *Anacamptis pyramidalis*, are attached to the same viscid disk; but, differently from those in that species, after being removed from the anther-cases, they first converge and then undergo the movement of depression. But the most interesting peculiarity in this species is that insects suck nectar out of minute open cells in the honeycombed surface of the labellum. Mr. Moggridge saw this plant fertilized by a large bee, the *Xylocopa violacea.* He adds some observations on *Orchis hircina*, and describes the structure and manner of fertilization of *Serapias cordigera* by another bee, viz. the *Ceratina albilabris.* In this *Serapias* both pollinia are attached to the same viscid disk; when first withdrawn, they are bent backwards, but soon afterwards move forwards and downwards in the usual manner. As the stigmatic cavity is narrow, the pollinia are guided into it by two guiding plates.

Mr. Moggridge sent me from Northern Italy living plants of *Orchis* or *Neotinea intacta*, together with excellent drawings and a full account of the structure of the flower. He informed me that this species is remarkable for producing seed without the aid of insects; and I ascertained that when insects were carefully excluded, almost all the flowers produced capsules. Their fertilization follows from the pollen being extremely incoherent, and spontaneously falling on the stigma. Nevertheless a short nectary is present, the pollinia possess

small viscid disks, and all the parts are so arranged that, if insects were to visit the flowers, the pollen-masses would probably be removed and then carried to another flower, but not so effectually as with most other orchids. We shall hereafter find a few other cases of orchids which have structural peculiarities adapted both for self-fertilization and for crossing. I may here also refer to a paper by Mr. R. Trimen (Journ. Linn. Soc. vol. vii. Botany, 1863, p. 144) on the beautiful *Disa grandiflora* of the Cape of Good Hope. This orchid presents several remarkable characteristics, one of these being that the pollinia do not spontaneously undergo any movement of depression, the weight of the pollen-masses sufficing to bend the caudicle into the proper curvature for the act of fertilization. Another peculiarity is that the posterior sepal secretes nectar, and is developed into a spur-like nectary. Mr. Trimen informs me that he has seen a Dipterous insect, allied to *Bombylius*, frequenting the flowers. I may add that Mr. Trimen has sent me descriptions and specimens of various other South-African orchids, which confirm the general conclusions at which I have arrived in my work.

On the movement of the pollinia of Ophrys muscifera (p. 56).—Mr. T. H. Farrer, who has lately been attending to the fertilization of various plants, has convinced me that I have erred, and that the pollinia of this *Ophrys* do undergo a movement of depression. Hence my remarks on the correlation of the various parts of the flower are to a certain extent invalidated; but there can be no doubt that the naturally bent caudicle plays an important part in placing the pollen-mass in a proper position for striking the stigma. I have continued occasionally to watch the flowers of this species, but have never succeeded in seeing insects visit them; but I have been led to suspect that they puncture or gnaw the small lustrous prominences beneath the viscid disks, which, I may add, are likewise present in several allied species. I have observed very minute punctures on these prominences, but I could not decide whether these had been made by insects or whether superficial cells had spontaneously burst.

Ophrys aranifera (p. 63).—F. Delpino states (Fecondazione nelle Piante &c., Firenze, 1867, p. 19) that he has examined in Italy thousands of specimens of this *Ophrys*, and that it seldom produces capsules. It does not secrete any nectar. Although he never saw an insect on the flowers (excepting once a green locust), nevertheless they are fertilized by insects; for he found pollen on the stigmas of some flowers, which had their own pollinia still within the anther-cases. The pollinia never

spontaneously fall out. He appears to think that I infer that this *Ophrys* fertilizes itself, which is an error.

Ophrys apifera (p. 71).—Prof. Treviranus at first doubted (Botanische Zeitung, 1862, p. 11) the accuracy of my account of this *Ophrys*, and of the differences between it and *O. arachnites*; but he has subsequently (Bot. Zeit. 1863, p. 241) fully confirmed all that I have stated.

Ophrys arachnites (p. 72).—I have now examined several additional living specimens of this *Ophrys*, and can confirm my statement that the pollinia do not fall out of the anther-cases, even when the spikes are strongly shaken; nor do they fall out when the spikes are kept standing in water for a week. Mr. J. Moggridge has made (Journ. Linn. Soc., Bot. vol. viii. 1865, p. 258) a remarkable observation on *O. scolopax*, which is closely allied to *O. arachnites*,—namely, that at Mentone it never exhibits any tendency to self-fertilization, whilst at Cannes all the flowers fertilize themselves, owing to a slight modification in the curvature of the anther, which causes the pollinia to fall out. This botanist has given, in his 'Flora of Mentone,' a full description, with excellent figures, of *O. scolopax*, *arachnites*, *aranifera*, and *apifera*; and he believes, from the number of intermediate forms, that they must all be ranked as varieties of a single species, and that their differences are intimately connected with their period of flowering. It does not appear that these forms in England, judging from their distribution, are liable to pass into each other, within any moderate or observable period of time.

On the fertilization of Herminium monorchis (p. 74).—My son, Mr. George Darwin, has fully observed the manner of fertilization of this minute and rare orchis. It differs from that of any other genus known to me. He saw the flowers entered by various minute insects, and brought home no less than twenty-seven specimens with pollinia (generally with only one, but sometimes with two) attached to them. These insects consisted of minute Hymenoptera (of which *Tetrastichus diaphantus* was the commonest), of Diptera and Coleoptera, the latter being *Malthodes brevicollis*. The one indispensable point appears to be that the insect should be of very minute size, the largest being only the $\frac{1}{20}$ of an inch in length. It is an extraordinary fact that in all the specimens the pollinia were attached to the same peculiar spot, namely, to the outer side of one of the two front legs, to the projection formed by the articulation of the femur with the coxa. In one instance alone a pollinium was attached to the outside of the femur a little beneath the articulation. The cause of this peculiar manner of attachment is sufficiently clear: the middle part

of the labellum stands so close to the anther and stigma, that insects always enter the flower at one corner, between the margin of the labellum and one of the upper petals; they also almost always crawl in with their backs turned directly or obliquely towards the labellum. My son saw several which had begun to crawl into the flower in a different position; but they came out and changed their position. Thus, standing in either corner of the flower, with their backs turned towards the labellum, they inserted their heads and fore legs into the short nectary, which is seated between the two widely separated viscid disks. I ascertained that they stand in this position by finding three dead insects, which had been permanently glued to the disks. Whilst sucking the nectar, which occupies about two or three minutes, the projecting joint of the femur stands under the large helmet-like viscid disk on either side; and when the insect retreats, the disk exactly fits on, and is glued to, the prominent joint. The movement of depression in the caudicle then takes place, and the mass of pollen-grains projects just beyond the tibia; so that the insect, when entering another flower, can hardly fail to fertilize the stigma, which is situated directly beneath the disk on either side. I know of hardly any other case in which the whole structure of the flower is more beautifully correlated than in the *Herminium* for a most peculiar manner of fertilization.

On the movement of the pollinia in Peristylus viridis (p. 76).—Mr. T. H. Farrer informs me that the pollinia certainly undergo a movement of depression, but that this does not take place until twenty or thirty minutes have elapsed after their removal from the anther-cases. This length of time probably accounts for my oversight. He asserts that, after the movement of depression, the pollinia become much better adapted to strike the stigmatic surface. He suggests that insects may take a long time to lick up the nectar from the two naked spots on the labellum, and through the narrow slit-like opening into the nectary—and that during this time the pollinium becomes firmly attached, by the slow hardening of the viscid matter, to the insect's body, so as to be subsequently ready to fertilize another flower when visited by the same insect.

On the Lepidoptera which fertilize the Gymnadenia conopsea, *and on the divergence of the pollinia* (p. 82).—Mr. George Darwin went at night to a bank where this species grows plentifully, and soon caught *Plusia chrysitis* with six pollinia, *P. gamma* with three, *Anaitis plagiata* with five, and *Triphæna pronuba* with seven pollinia attached to their proboscides.

I may add that he caught the first-named moth, bearing the pollinia of this orchis, in my flower-garden, although more than a quarter of a mile distant from any spot where the plant grows. I state in my work that I do not understand the cause of the divergence of the pollinia so that they are enabled to strike the lateral stigmatic surfaces; but the explanation is simple. The upper margin of the nectary is arched, being formed on one side by the disk of one pollinium, and on the other side by the other disk. Now if a moth inserts its proboscis obliquely, and there are no guiding-ridges by which, as in *Anacamptis pyramidalis*, a moth is compelled to insert its proboscis directly in front, or if a bristle be inserted obliquely, one pollinium alone is removed. In this case the pollinium becomes attached a little on one side of the bristle or proboscis; and its extremity, after the vertical movement of depression, occupies a proper position for striking the lateral stigma on the same side.

On the Gymnadenia tridentata *of North America* (p. 83).—Prof. Asa Gray has published (American Journal of Science, vol. xxxiv. 1862, p. 426, and footnote p. 260; and vol. xxxvi. 1863, p. 293) some interesting notes on the *Gymnadenia tridentata*. The anther opens in the bud, and some of the pollen invariably falls on the naked cellular tip of the rostellum; and this part, strange to say, is penetrated by the pollen-tubes, so that the flowers are self-fertilized. Nevertheless "all the arrangements for the removal of the pollinia by insects (including the movement of depression) are as perfect as in the species which depend upon insect aid." Hence there can be little doubt that this species is occasionally crossed.

Habenaria or *Platanthera bifolia* (p. 88).—According to Dr. H. Müller, of Lippstadt, *Pl. bifolia* of English authors is the *Pl. solstitialis* of Boenninghausen; and he fully agrees with me that it must be ranked as specifically distinct from *Pl. chlorantha*. Dr. Müller states that this latter species is connected by a series of gradations with another form which in Germany is called *Pl. bifolia*. He gives a very full and valuable account of the variability of these species of *Platanthera* and of their structure in relation to their manner of fertilization. (See Verhandl. d. Nat. Verein. Jahrg. xxv. III. Folge, v. Bd. pp. 36–38.)

American species of Platanthera (p. 91).—Prof. Asa Gray has described (American Journal of Science, vol. xxxiv. 1862, pp. 143, 259, & 424, and vol. xxxvi. 1863, p. 292) the structure of ten American species of *Platanthera*. Most of these resemble in their manner of fertilization the two British species described by me; but some of them, in which the viscid

disks do not stand far apart, have curious contrivances, such as a channelled labellum, lateral shields, &c., compelling moths to insert their proboscides directly in front. *Pl. Hookeri*, on the other hand (*ibid.* vol. xxxiv. 1862, p. 143), differs in a very interesting manner: the two viscid disks stand widely separated from each other; consequently a moth, unless of gigantic size, would be able to suck the copious nectar without touching either disk; but this risk is avoided in the following manner:—The central line of the stigma is prominent, and the labellum, instead of hanging down, as in most of the other species, is curved upwards, so that the front of the flower is made somewhat tubular and is divided into two halves. Thus a moth is compelled to go to one or the other side, and its face will almost certainly be brought into contact with one of the disks. The drum of the pollinium, when removed, contracts in the same manner as I have described under *Pl. chlorantha.* Prof. Gray has seen a butterfly from Canada with the pollinia of this species attached to each eye. In the case of *Platanthera flava* (American Journal of Science, vol. xxxvi. 1863, p. 292), moths are compelled in a different manner to enter the nectary on one side. A narrow but strong protuberance, rising from the base of the labellum, projects upwards and backwards, so as almost to touch the column; thus the moth, being forced to go to either side, is almost sure to withdraw one of the viscid disks. In the allied and wonderful *Bonatea speciosa* of the Cape of Good Hope there is a similar contrivance for the same purpose.

Platanthera hyperborea and *dilatata* have been regarded by some botanists as varieties of the same species; and Prof. Asa Gray says (Amer. Journ. of Science, vol. xxxiv. 1862, pp. 259 & 425) that he has often been tempted to come to the same conclusion; but now, on closer examination, he finds, besides other characters, a remarkable physiological difference, namely, that *Pl. dilatata*, like its congeners, requires insect aid and cannot fertilize itself; whilst in *Pl. hyperborea* the pollen-masses commonly fall out of the anther-cells whilst the flower is very young or in bud, and thus the stigma is self-fertilized. Nevertheless the various structures adapted for crossing are still present.

Fertilization of Epipactis palustris (p. 102).—My son, Mr. W. E. Darwin, has carefully observed for me this plant in the Isle of Wight. Hive-bees seem to be the chief agents in fertilization; for he saw about a score of flowers visited by these insects, many of which had pollen-masses attached to their foreheads, just above the mandibles. I had supposed that insects crawled into the flowers; but hive-bees are too large to

do this; they always clung, whilst sucking the nectar, to the distal and hinged half of the labellum, which was thus pressed downwards. Owing to this part being elastic and tending to spring up, the bees, as they left the flowers, seemed to fly rather upwards; and this would favour, in the manner explained by me, the complete withdrawal of the pollen-masses, quite as well as an insect crawling out of the flower in an upward direction. Perhaps, however, this upward movement may not be so necessary as I had supposed; for, judging from the point at which the pollen-masses were attached to the bees, the back part of the head would press against, and thus lift up, the blunt, solid, upper end of the anther, thus freeing the pollen-masses.

Various other insects besides hive-bees visit this *Epipactis*. My son saw several large flies (*Sarcophaga carnosa*) haunting the flowers; but they did not enter in so neat and regular a manner as the hive-bees; nevertheless two had pollen-masses attached to their foreheads. Several smaller flies (*Cœlopa frigida*) were also seen entering and leaving the flowers, with pollen-masses adhering rather irregularly to the dorsal surface of the thorax. Three or four distinct kinds of Hymenoptera (one of small size being *Crabro brevis*) likewise visited the flowers; and three of these Hymenoptera had pollen-masses attached to their backs. Other still more minute Diptera, Coleoptera, and ants were seen sucking the nectar; but these insects appeared to be too small to transport the pollen-masses. It is remarkable that some of the foregoing insects should visit these flowers; for Mr. F. Walker informs me that the *Sarcophaga* frequents decaying animal matter, and the *Cœlopa* haunts seaweed, occasionally settling on flowers; the *Crabro* also, as I hear from Mr. F. Smith, collects small beetles (*Halticæ*) for provisioning its nest. It is equally remarkable, seeing how many kinds of insects visit this *Epipactis*, that, although my son watched for some hours on three occasions hundreds of plants, not a single humble-bee alighted on a flower, though many were flying about. In a footnote I have given the results of experiments made by Mr. More, by cutting off the distal and hinged half of the labellum, in order to ascertain how far this part is important. He has now repeated the experiment on nine additional flowers: of these, three did not produce seed-capsules; but this may have been accidental. Of six capsules which were produced, two contained about as many seeds as the capsules of unmutilated flowers on the same plant; but four capsules contained much fewer seeds. The seeds themselves were well-formed. These experiments, as far as they go, support the view that the distal part of the

labellum plays an important part in leading insects to enter and leave the flower in a proper manner for fertilization.

Fertilization of Epipactis latifolia (p. 104).—Although this orchis is not common in the vicinity of Down, by a fortunate chance several plants sprang up in a gravel walk close to my house, so that I have been able to observe them during several years, and have thus discovered how they are fertilized. Although hive-bees and humble-bees of many kinds were constantly flying over the plants, I never saw a bee or any Dipterous insect visit the flowers; whilst, on the other hand, I repeatedly observed each year the common wasp (*Vespa sylvestris*) sucking the nectar out of the open cup-shaped labellum. I thus saw the act of fertilization effected by the pollen-masses being removed and carried on the foreheads of the wasps to other flowers. Mr. Oxenden also informs me that a large bed of *E. purpurata* (which is considered by some botanists a distinct species, and by others a variety) was frequented by "swarms of wasps." It is very remarkable that the sweet nectar of this *Epipactis* should not be attractive to any kind of bee. If wasps were to become extinct in any district, so would the *Epipactis latifolia.*

Dr. H. Müller of Lippstadt has published (Verhandl. d. Nat. Ver. Jahrg. xxv. III. Folge, v. Bd. pp. 7–36) some very important observations on the differences in structure and in the manner of fertilization, as well as on the connecting gradations, between *Epipactis rubiginosa*, *microphylla*, and *viridiflora.* The latter species is highly remarkable by the absence of a rostellum, and by being regularly self-fertilized. This latter circumstance follows from the incoherent pollen of the lower part of the pollen-masses emitting, whilst still within the anther-cells, pollen-tubes, which penetrate the stigma; and this occurred even in the bud state. This species, however, is probably visited by insects, and occasionally crossed; for the labellum contains nectar. *E. microphylla* is equally remarkable, by being intermediate in structure between *E. latifolia*, which is always fertilized by the aid of insects, and *E. viridiflora*, which does not necessarily require any such aid. The whole of this memoir by Dr. H. Müller deserves to be attentively studied.

flora (p. 108).—During the year 1862, the flowers of this orchis appeared to have been visited much less frequently by insects than during the previous years; for the masses of pollen were seldom broken down. Although I have repeatedly examined the flowers, I have never seen a trace of nectar; but some appearances lead me to suspect that the ridges within the base of the labellum are attractive to

insects, and are gnawed by them, as in the case of many Vandeæ and other exotic orchids.

Goodyera repens (p. 114).—Mr. R. B. Thomson informs me that in the north of Scotland he saw many humble-bees visiting the flowers and removing the pollen-masses, which were attached to their proboscides. The bee sent was *Bombus pratorum*. This species grows also in the United States; and Prof. Gray (Amer. Journ. of Science, vol. xxxiv. 1862, p. 427) confirms my account of its structure and manner of fertilization, which is likewise applicable to another and very distinct species, namely, *Goodyera pubescens*. Prof. Gray states that the passage into the flower, which is at first very narrow, becomes, as I suspected, more open during its older state. Prof. Gray believes, however, that it is the column, and not the labellum, which changes its position.

Spiranthes autumnalis (p. 123).—As in the case of the *Goodyera*, Prof. Gray feels confident that it is the column which moves from the labellum as the flower grows older, and not, as I had supposed, the labellum which moves from the column. He adds that this change of position, which plays so important a part in the fertilization of the flower, "is so striking that we wonder how we overlooked it" (Amer. Journ. of Science, vol. xxxiv. p. 427).

On the rostellum of Listera ovata *not exploding spontaneously* (p. 149).—I have covered up some additional plants, and found that the rostellum lost its power of explosion in about four days, the viscid matter then turning brown within the loculi of the rostellum. The weather at the time was unusually hot, and this may have hastened the process. After the four days had elapsed, the pollen had become very incoherent and some had fallen on the two corners, or even over the whole surface, of the stigma, which was penetrated by the pollen-tubes. Hence, if insects should fail to remove the pollinia by causing the explosion of the rostellum, this orchid certainly seems capable of occasional self-fertilization. But the scattering of the incoherent pollen was largely aided by, and perhaps wholly depended on, the presence of *Thrips*—insects so minute that they could not be excluded by any net.

Listera cordata (p. 152).—Prof. Dickie has been so good as to observe the flowers on living plants. He informs me that, when the pollen is mature, the crest of the rostellum is directed towards the labellum, and that, as soon as touched, the viscid matter explodes, the pollinia becoming attached to the touching object; after the explosion, the rostellum bends downwards and spreads out, thus protecting the virgin stigmatic surface; subsequently the rostellum rises and exposes

the stigma; so that everything here goes on as I have described under *Listera ovata.* The flowers are frequented by minute Diptera and Hymenoptera.

On the self-fertilization of Neottia nidus-avis, *and on the rostellum not exploding spontaneously* (p. 153).—I covered up with a net several plants, and after four days found that the rostellum had not spontaneously exploded, and had already almost lost this power. The pollen had become incoherent, and in all the flowers much had fallen on the stigmatic surfaces, which were penetrated by pollen-tubes. The spreading of the pollen seemed to be in part caused by the presence of *Thrips*, many of which minute insects were crawling about dusted all over with pollen. The covered-up plants produced plenty of capsules, but these were much smaller and contained much fewer seeds than the capsules produced by the adjoining uncovered plants. I may here add that I detected on the crest of the rostellum some minute rough points, which seemed *particularly* sensitive in causing the rostellum to explode.

Dr. H. Müller, of Lippstadt, informs me that he has seen Diptera sucking the nectar and removing the pollinia of this plant.

On the self-fertilization of certain Epidendreæ (p. 166).—Dr. Crüger says (Journ. Linn. Soc. vol. viii., Botany, 1864, p. 131) that "we have in Trinidad three plants belonging to the Epidendreæ (a *Schomburgkia*, *Cattleya*, and *Epidendron*) which rarely open their flowers, and are invariably impregnated when they do open them. In these cases it is easily seen that the pollen-masses have been acted on by the stigmatic fluid, and that the pollen-tubes descend from the pollen-masses *in situ* down into the ovarian canal." Mr. Anderson, a skilful cultivator of orchids in Scotland, informs me (see also 'Cottage Gardener,' 1863, p. 206) that with him the flowers of *Dendrobium cretaceum* never expand, and yet produce capsules with plenty of seed, which, when examined by me, was found to be perfectly good. These orchids make a near approach to those dimorphic plants (as *Oxalis*, *Ononis*, and *Viola*) which habitually produce open and perfect, as well as closed and imperfect flowers.

On the slow movement of the pollinia in Oncidium (p. 189).—Mr. Charles Wright, in a letter to Prof. Asa Gray, states that he observed in Cuba a pollinium of an *Oncidium* attached to a *Bombus*, and he concluded at first that I was completely mistaken about the movement of depression; but after several hours the pollinium moved into the proper position for fertilizing the flower.

Manner of fertilization of various exotic Orchids (p. 189).

—I may here remark that Delpino (Fecondazione nelle Piante, Firenze, 1867, p. 19) says he has examined flowers of *Vanda*, *Epidendron*, *Phaius*, *Oncidium*, and *Dendrobium*, and confirms my general statements. The late Prof. Bronn, in his German translation of this work (1862, p. 221), gives a description of the structure and manner of fertilization of *Stanhopea devoniensis*.

Sexes of Acropera *not separated* (p. 206).—I have committed a great error about this genus, in supposing that the sexes were separate. Mr. J. Scott, of the Royal Botanic Garden of Edinburgh, soon convinced me that it was an hermaphrodite, by sending me capsules containing good seed, which he had obtained by fertilizing some flowers with pollen from the same plant. He succeeded in doing this by cutting open the stigmatic chamber, and inserting the pollen-masses. My error arose from my ignorance of the remarkable fact that, as shown by Dr. Hildebrand (Botanische Zeitung, 1863, Oct. 30 *et seq.*, and Aug. 4, 1865), in many orchids the ovules are not developed until several weeks or even months after the pollen-tubes have penetrated the stigma. No doubt if I had examined the ovaria of *Acropera* some time after the flowers had withered, I should have found well-developed ovules. In many exotic orchids besides *Acropera* (namely, in *Gongora*, *Cirrhæa*, *Acineta*, *Stanhopea*, &c.), the entrance into the stigmatic chamber is so narrow that the pollen-masses cannot be inserted without the greatest difficulty. How fertilization is effected in these cases is not yet known. That insects are the agents there can be no doubt; for Dr. Crüger saw a bee (*Euglossa*) with a pollinium of a *Stanhopea* attached to its back; and bees of the same genus continually visit *Gongora*. Fritz Müller has observed, in the case of *Cirrhæa* (Bot. Zeitung, Sept. 1868, p. 630), that if one end of the pollen-mass be inserted into the narrow entrance of the stigmatic chamber, this part, from being bathed by the stigmatic fluid, swells, and the whole pollen-mass is thus gradually drawn into the stigmatic entrance. But, from observations which I have made on *Acropera* and *Stanhopea* in my own hot-house, I suspect that, with many of these orchids, the pedicel with the narrow end of the pollinium, and not the broad end, is ordinarily inserted into the stigmatic chamber. By thus placing the pollinium, I have occasionally succeeded in fertilizing some of these orchids, and have obtained seed-capsules.

Structure and fertilization of the Vandeæ *&c. of Brazil* (p. 210).—Fritz Müller has sent me many letters containing an astonishing number of new and curious observations on the structure and manner of cross-fertilization of various orchids

inhabiting South Brazil. I much regret that I have not here space or time to give an abstract of his many discoveries, which support the general conclusions given in my work; but I hope that he will some day be induced to publish a full account of his observations.

Fertilization of Catasetum (p. 211).—It has been highly satisfactory to me that my observations and predictive conclusions in regard to *Catasetum* have been fully confirmed by the late Dr. Crüger, the Director of the Botanic Gardens of Trinidad, in letters to me and in his paper in the 'Journal of the Linnean Society' (vol. viii. Bot. 1864, p. 127). He sent me specimens of the bees, belonging to three species of *Euglossa*, which he saw gnawing the inside of the labellum. The pollinia, when ejected, become attached to, and lie flat on, the backs of the bees, on the hairy surface of the thorax. Dr. Crüger has also proved that I was correct in asserting that the sexes of *Catasetum* are separate, for he fertilized female flowers with pollen from the male plants; and Fritz Müller effected the same thing with *Catasetum mentosum* in South Brazil. Nevertheless, from two accounts which I have received, it appears that *Catasetum tridentatum*, though a male plant, occasionally produces seed-capsules; but every botanist knows that this occasionally occurs with the males of other dioecious plants. Fritz Müller has given (Botanische Zeitung, Sept. 1868, p. 630) a most interesting account, agreeing with mine, of the state of the minute pollinia in the female plant: the anther never opens, and the pollen-masses are not attached to the viscid disks, so that they cannot be removed by any natural means. The pollen-grains, as so generally occurs with rudimentary organs, are extremely variable in size and shape. Nevertheless the grains of the rudimentary pollen-masses belonging to the female plant, when applied (which can never naturally occur) to the stigmatic surface, emitted their pollen-tubes! This appears to me a very curious instance of the slow and gradual manner in which structures are modified; for the female pollen-masses, included within an anther which never opens, are seen still partially to retain their former powers and function.

Mormodes luxatum (p. 265).—I have now examined another species of *Mormodes*, the rare *M. luxatum*, and I find that the chief points of structure, and the action of the different parts, including the sensitiveness of the filament, are the same as in *M. ignea*. The cup of the labellum, however, is much larger, and is not pressed down firmly on the filament on the summit of the column. This cup probably serves to attract insects, and, as in *Catasetum*, is gnawed by them. The flowers

are asymmetrical to an extraordinary degree, the right-hand and left-hand sides differing much in shape.

Cycnoches ventricosum (p. 265).—The plant described in my work as a second species of *Mormodes* proves to be *Cycnoches ventricosum*. I first received from Mr. Veitch some flower-buds, from which the section (fig. xxx.) was taken; but subsequently he sent me some perfect flowers. The yellowish-green petals and sepals are reflexed; the thick labellum is singularly shaped, with its upper surface convex, like a shallow basin turned upside down. The thin column is of extraordinary length, and arches like the neck of a swan over the labellum; so that the whole flower presents a very singular appearance. In the section of the flower, given in my work, we see the elastic pedicel of the pollinium bowed, as in *Catasetum* or *Mormodes*; but at the period of growth represented in the figure the pedicel was still united to the rostellum, the future line of separation being shown by a layer of hyaline tissue indistinct towards the upper end of the disk. The disk is of gigantic size, and its lower end is produced into a great fringed curtain, which hangs in front of the stigmatic chamber. The viscid matter of the disk sets hard very quickly, and changes colour. The disk adheres to any object with surprising strength. The anther is very different in shape from that of *Catasetum* or *Mormodes*, and apparently would retain the pollen-masses with greater force. A part of the filament of the anther, lying between two little leaf-like appendages, is sensitive; and when this part is touched, the pollinium is swung upwards, as in *Mormodes*, and with sufficient force, if no object stands in the way, to throw it to the distance of an inch. An insect of large size alights probably on the labellum, for the sake of gnawing the convex surface, or perhaps on the extremity of the arched and depending column, and then, by touching the sensitive point, causes the ejection of the pollen-masses, which are affixed to its body and thus transported to another flower or plant.

Fertilization of the Arethuseæ (p. 269).—*Epipogium Gmelini* has been the subject of an admirable memoir (Ueber den Blüthenbau, &c., Göttingen, 1866) by Dr. P. Rohrbach, who has shown how the flowers are fertilized by *Bombus lucorum*. With respect to another genus belonging to this same tribe, namely *Pogonia*, Dr. Scudder of the United States has described (Proc. Boston Nat. Hist. Soc. vol. ix. 1863, p. 182) the manner in which it is fertilized by the aid of insects.

Cypripedium (p. 274).—Prof. Asa Gray, after examining several American species of *Cypripedium*, wrote to me (see also Amer. Journ. of Science, vol. xxxiv. 1862, p. 427) that

he was convinced that I was in error, and that the flowers are fertilized by small insects entering the labellum through the large opening on the upper surface, and crawling out by one of the two small orifices close to either anther and the stigma. Accordingly I caught a very small bee which seemed of about the right size, namely the *Andrena parvula* (and this by a strange chance proved, as we shall presently see, to be the right genus), and placed it in the labellum through the upper large opening. The bee vainly endeavoured to crawl out again the same way, but always fell backwards, owing to the margins being inflected. The labellum thus acts like one of those conical traps with the edges turned inwards, which are sold to catch beetles and cockroaches in the London kitchens. Ultimately the little bee forced its way out through one of the small orifices close to one of the anthers, and was found when caught to be smeared with the glutinous pollen. I then again put the same bee into the labellum; and again it crawled out through one of the small orifices. I repeated the operation five times, always with the same result. I then cut away the labellum, so as to examine the stigma, and found it well smeared over with pollen. Delpino (Fecondazione &c. 1867, p. 20) with much sagacity foresaw that some insect would be discovered to act in the manner just described; for he argued that if an insect were to insert its proboscis, as I had supposed, from the outside through one of the small orifices close to one of the anthers, the stigma would be fertilized by the plant's own pollen; and in this he did not believe, from having confidence in what I have often insisted on—namely, that all the contrivances for fertilization are arranged so that the stigma shall receive pollen from a distinct flower or plant. But these speculations are now all superfluous; for, owing to the admirable observations of Dr. H. Müller, of Lippstadt (Verh. d. Nat. Ver. Jahrg. xxv. III. Folge, v. Bd. p. 1), we actually know that *Cypripedium calceolus* in a state of nature is fertilized by two species of *Andrena*, in the manner above supposed.

On the relation between the more or less viscid condition of the pollen and stigma in Cypripedium (p. 276).—The relation between the state of the pollen and stigma, which I have pointed out in my work, is strongly confirmed by Prof. Gray's statement (Amer. Journ. of Science, vol. xxxiv. 1862, p. 428), namely, that in *C. acaule* the pollen is much more granular or less viscid than in other American species of the genus, and in this species alone the stigma is slightly concave and viscid! Dr. Gray adds that in most of the species the broad stigma presents another remarkable peculiarity, "in being closely

beset with minute, rigid, sharp-pointed papillæ, all directed forwards, which are excellently adapted to brush off the pollen from an insect's head or back."

The use of the copious fluid contained within the labellum of Coryanthes (p. 278).—The *Coryanthes macrantha* is perhaps the most wonderful of all known orchids, even more wonderful in structure and function than *Catasetum*. Its manner of fertilization has been described by Dr. Crüger in the 'Journal of the Linnean Society' (vol. viii. Bot. 1864, p. 130), and in letters to me. He sent me bees, belonging to the genus *Euglossa*, which he saw at work. The fluid in the bucket formed by the basal part of the labellum is not nectar and does not attract insects, but serves, by wetting their wings, to prevent them from crawling out except through the small passages close to the anther and stigma. Thus the secretion of fluid in this orchis serves exactly the same end as the inflected margins of the labellum in *Cypripedium*.

On the evidence that Insects visit many exotic Orchids in order to gnaw parts of the labellum, and not for the sake of nectar (p. 284).—It has been highly satisfactory to me that this hypothesis has been fully confirmed. In the West Indies, Dr. Crüger witnessed humble-bees of the genus *Euglossa* gnawing the labellum of *Catasetum*, *Coryanthes*, *Gongora*, and *Stanhopea*; and Fritz Müller has repeatedly found, in South Brazil, the prominences on the labellum of *Oncidium* gnawed. We are thus enabled to understand the meaning of the various extraordinary crests and projections on the labellum of various exotic orchids; for they invariably stand in such a position that insects, whilst gnawing them, will be almost sure to touch the viscid disks of the pollinia, and thus remove them.

Bonatea speciosa (p. 305).—The manner of fertilization of this extraordinary orchis has now been fully described by Mr. R. Trimen in the 'Journal of the Linnean Society' (vol. ix. Bot. 1865, p. 156). A projection rising from the base of the labellum is one of its most remarkable peculiarities, as an insect is thus compelled to insert its proboscis on one side, and thus to touch one of the two widely separated and projecting viscid disks. Mr. J. P. Mansel Weale has also published (*ibid.* vol. x. 1869, p. 470) analogous observations on a second species, viz. *Bonatea Darwinii*. Mr. Weale caught a skipper-butterfly (*Pyrgus elmo*) quite embarrassed by the number of pollinia belonging to this orchis which adhered to its sternum. I do not know of any other case in which the pollinia adhere to the sternum of a Lepidopterous insect.

On the nature of the contraction which causes the pollinia, after their removal from the anther, to change their position

(p. 338).—In *Orchis hircina*, I clearly saw, under the microscope, the whole front of the viscid disk become depressed as the two pollinia together underwent the movement of depression.

Number of seeds (p. 344).—The number of seeds produced by *Orchis maculata*, as given in my work, is small in comparison with that produced by some foreign species. I have shown (Variation of Animals and Plants under Domestication, vol. ii. 1868, p. 379), on the authority of Mr. Scott, that a single capsule of *Acropera* contained 371,250 seeds; and the species produces so many flowers and racemes, that a single plant probably sometimes produces as many as 74 millions of seeds in the course of a single year. Fritz Müller carefully estimated, by weighing, the number of seeds in a single capsule of a *Maxillaria* in South Brazil, and found the number 1,756,440. The same plant sometimes produces half-a-dozen capsules.

Number of pollen-grains (p. 355).—I have endeavoured to estimate the number of pollen-grains produced by a single flower of *Orchis mascula*. There are two pollen-masses; in one of these I counted 153 packets of pollen; each packet contains, as far as I could count, by carefully breaking it up under the microscope, nearly 100 compound grains; and each compound grain is formed of four grains. By multiplying these figures together, the product for a single flower is about 120,000 pollen-grains. Now we have seen that in the allied *O. maculata* a single capsule produced about 6,200 seeds; so that there are nearly twenty pollen-grains for each ovule or seed. As a single flower of a *Maxillaria* produced 1,756,000 seeds, it would produce, according to the above ratio, nearly 34 million pollen-grains, each of which, no doubt, includes the elements for the reproduction of every single character in the mature plant!

Enumeration of the Orchideæ *which, as at present known, habitually fertilize themselves* (p. 358).—We have now seen that self-fertilization habitually occurs, in a more or less perfect manner, in one of the species of *Ophrys*, of *Neotinea*, *Gymnadenia*, *Platanthera*, *Epipactis*, *Cephalanthera*, *Neottia*, and in those *Epidendreæ* and in *Dendrobium* which often produce flowers that never expand. No doubt other cases will hereafter be discovered. Self-fertilization seems to be more perfectly secured in *Ophrys apifera* and in *Neotinea intacta* than in the other species. But it deserves especial notice that in all these orchids structures are still present, not in a rudimentary condition, which are manifestly adapted for the transport by insects of the pollen-masses from one flower to another. As I have elsewhere remarked, some plants, both indigenous

and naturalized, rarely or never bear flowers, or, if they do bear flowers, these never produce seed. But no one doubts that it is a general law of nature that phanerogamic plants should produce flowers, and that these flowers should produce seed. When they fail to do this, we believe that such plants would perform their proper functions under different conditions, or that they formerly did so and will do so again. On analogical grounds I believe that the few orchids which do not now intercross, either did formerly intercross (the means for effecting this being still retained) or that they will do so at some future period under different conditions, unless, indeed, they become extinct from the evil effects of long-continued close interbreeding.

XVII.—*Note on* Hyponome Sarsi, *a recent Cystidean.* By S. Lovén*.

The general appearance of this very remarkable Echinoderm is that of a small starfish or a Euryalid. It has a disk, convex on the ventral surface, flattened on the dorsal, and five short and broad rays; each of these is divided into two short dichotomous branches, terminating in four very short rounded lobes. As in the recent genera *Antedon* and *Pentacrinus*, a large, conical, proboscis-like funnel rises in one of the interradial spaces of the ventral surface of the disk; and from a point situated a little before the centre of the same surface five narrow channels, protected by marginal scales, radiate and, bifurcating thrice, run out on the rays and their branches, giving off short branchlets to certain sacculate protuberances placed at regular distances. No pinnulæ. On the protuberances and on the rays the channels are open; but upon the disk, between their first bifurcation and their common starting-point, their marginal scales close over them, forming a vault, so that the five channels are converted into covered ducts, converging into a common subcentral aperture, concealed beneath the integument, and not visible from the outside. In the covered parts of the channels I found masses, consisting of microscopic Crustacea, larval bivalves, and other remains of the food of the animal, apparently taken through the ends and open parts of the channels, and on its way, through their covered parts, to the concealed mouth. On the rays, near their tips, are seen some few pores, perhaps indicating the existence of retractile organs. The ventral surface is clothed with rather small, thick-set,

* We are indebted to the Author for the communication of this translation from 'Forhandlinger ved de Skandinaviske Naturforskeres tiende Möde, i Christiania,' July 1868.

irregular whitish scales, among which, in certain places, some six or seven larger ones are seen forming a rosette. Between the rays and their bifurcations this scaly covering of the ventral surface extends back on to the dorsal surface, ending there with great regularity in triangular spaces pointing to the centre of the disk. The remainder of the dorsal surface of the disk and the rays, which, by this arrangement, assumes the form of a regular star with five broad dichotomous rays, is clothed with a soft and smooth brownish skin. There is no trace of a calyx. In the centre of the even dorsal face of the disk is seen a somewhat pentagonal space studded with minute pores.

To have the channels on the disk converted into tunnel-like passages leading to a mouth concealed beneath the integument is a peculiarity hitherto not observed in any recent Crinoid; but it is, as shown by Professor Huxley and Mr. Billings, a characteristic of the palæozoic Crinoids and Cystideans. The absence of any indication of a calyx at once excludes *Hyponome* from the former. Among the Cystideans it recalls the genus *Agelacrinites*, of Vanuxem, by the depressed form of the body, the scaly covering, and the flatness of the dorsal surface, devoid of anything like a stem or peduncle, as also by the absence of pectinated rhombs and of pinnulæ. Branchlets running from the channels to sacculate protuberances are found also in the genus *Glyptocystites* of Billings and *Glyptosphærites* of Johannes Müller; and bifurcations of the channels are met with in *Sphærocystites* and *Callocystites* of Hall. Lastly, the genus *Hyponome* shares with the surviving type of the Crinoidea the radiated form of the body and the simply conical unprotected funnel.

The specimen described is from Cape York, Torres Strait.

XVIII.—*Descriptions of a remarkable new Jellyfish and two Actinians from the coast of Maine.* By A. E. Verrill *.

During an excursion to the coast of Maine and Bay of Fundy last season, many interesting and rare marine animals were observed and collected by myself and companions †. Among the most remarkable new species is a very large and beautiful Discophorous jellyfish, which is the type of a new genus, and represents a family previously unknown upon our Atlantic coast.

In size and general appearance it has some resemblance to *Cyanea arctica*, for which it may, possibly, have been hitherto mistaken by casual observers; for it seems scarcely probable

* From Silliman's American Journal, July 1869.

† Messrs. S. I. Smith, G. A. Jackson, H. E. Webster, and E. F. Verrill.

that such a large and conspicuous species, which occurred twice among the wharves at Eastport, could otherwise have so long escaped observation. Its colour, however, is much lighter than that of *Cyanea*, and yellowish rather than brown or reddish, while the much less numerous tentacles are larger, flattened, with one edge crenulated and bordered with white; and its entire structure is quite different.

It is far more nearly allied to *Hexadecomma ambiguum*, Brandt, of the North Pacific; but the latter is represented with round tentacles, different marginal lobes and ovaries, and broader and much more complicated mouth-folds.

CALLINEMA, Verrill, gen. nov.*

Disk broad, moderately thick, with numerous broad channels running to the marginal one, arranged in sixteen systems, two or three parallel and undivided tubes alternating with a group of five or six branching ones, which unite together into one toward the central portion of the disk, each of which corresponds in position with one of the sixteen eye-bearing marginal lobes. Toward the marginal channel the branching tubes anastomose freely, the undivided ones but slightly or not at all, though two often unite into one near the margin. Margin deeply and regularly divided into scolloped lobes, sixteen of which bear eyes and are bilobed for more than half their length, bearing the eye at the division, just below which the channel in the lobe divides into two divergent branches, one of which goes to each division. Alternating with the eye-lobes are somewhat longer lobes, which are divided at the edge into two, three, or four rounded scollops, each of which receives a simple channel. Tentacles in a nearly regular circle, but arranged in groups of five or six at the bases of the interocular lobes, very long, highly contractile, flat; one edge double, finely scolloped, the scollops again finely crenulate. Ovaries large much convoluted pendent pouches. Lobes of the actinostome four, large, elongated, pointed, complexly lobed and frilled.

Callinema ornata, Verrill, sp. nov.

Disk large, up to 18 inches in diameter, with conspicuous radiating tubes ·1 to ·3 inch broad. Actinal appendages, when extended, about as long as the diameter of the disk, broad, much convoluted, and deeply frilled at base, the edges with fine papilliform divisions. Ovaries large, hanging loosely from the underside of the disk, and nearly equal in length to the radius of the disk. Tentacles ·2 inch broad, extending to

* κάλλος, beauty, νῆμα, thread.

the length of at least 15 feet in large specimens, capable of contracting to a length of less than six inches, about 80 or 90 in number, arranged in a nearly regular circle, one to each of the marginal scollops, except those of the eye-bearing lobes; double edge neatly scolloped, frilled and minutely crenulated.

Disk transparent, the radiating tubes light brownish yellow, the central area marked interiorly with lines of light orange, enclosing large, irregularly polygonal areas, below which the lobes of the actinostome show through, giving a yellow centre about three inches in diameter; outside of this the ovarian lobes, which are light brownish yellow, show through the disk and extend at times nearly to its margin. They are grouped somewhat into four divisions, and float about variously as the animal moves. Eyes pearl-white. Tentacles transparent, the complex edge flake-white. Actinal folds lemon-yellow or light buff. Lobes of the reproductive organs either yellowish white or brownish yellow, with darker borders of yellowish brown or orange-brown. Phosphorescent with white light. Diameter of largest specimen 18 inches; length of tentacles 15 feet or more, in extension. Another specimen was 10 inches in diameter; disk at centre 1·5 inch thick; largest marginal lobes 1·25 long, smallest ·75; actinal appendages 8–10 inches long; ovaries hang down 4 inches from disk; tentacles 12 feet long.

Eastport Harbour, swimming near the surface at noon; three specimens observed, one preserved in the museum of Yale College.

Edwardsia elegans, Verrill, sp. nov.

Body elongated, slender; epidermis thick, light yellowish brown, with entangled mud, the upper edge slightly free and prominent. Tentacles 16, slender, variously curved and entwined, pale flesh-colour, with a central longitudinal line of light orange-red; naked part below the disk pale pink, with longitudinal white lines corresponding with the internal lamellæ; mouth light yellowish; disk pale flesh-colour.

Eastport, Me., at low water under stones, rare; also on Indian Island, N. B.

Edwardsia farinacea, Verrill, sp. nov.

Body small, changeable in form, not very slender, often swollen in the middle or near the base, tapering upward; epidermis firm, dark yellowish, covered with small, firmly adherent grains of sand, the internal lamellæ showing through faintly, but becoming more distinct on the naked, transparent, protruded basal portion, which is marked by 12 corresponding whitish sulcations, meeting at the end and alternating with some finer lines. Upper part of column transparent and naked

for about ·12 inch. Tentacles 12, short, conical, in a single circle at the margin of the disk, not crowded, pale yellowish white, sprinkled with fine flake-white specks, which become more crowded on the inner median line and at the tips. Disk small, protruded; mouth largely dilatable, at times elevated on a cone; lips with 6 to 12 irregular lobes. Disk and naked space below the tentacles pale yellowish white, finely speckled with flake-white, the disk with faint whitish radiating lines. Length ·5 inch, greatest diameter ·15; diameter of disk ·12.

South Bay, Lubec, on a muddy bottom in 8 fathoms, rare.

XIX.—*Descriptions of new Species of Butterflies from Tropical America.* By Osbert Salvin, M.A., F.L.S., &c.*

1. *Olyras insignis.*

♂. Exp. 4·1 in. Antennæ yellow, black at the base; palpi black, with a lateral streak of white on each side; head black, with white spots round the eyes; prothorax black, with a yellow spot in the centre; thorax black tinged with yellow; wing-coverts black, with two white spots on each; abdomen dusky, black beneath, with an indistinct lateral line of white and white spots near the articulations beneath: anterior wings elongated, the anal angle much produced, diaphanous, yellow at the base, margins black; a black curved band crosses the cell to near the origin of the first median branch; the second median section is black, and meets a band which, crossing the wing through the end of the cell, passes along the second median branch to the outer margin; another indistinct band crosses the clear apical portion of the wing: posterior wings clear yellowish, outer margin broadly bordered with black, inside which, near the anal angle, is an edging of tawny red; nervures of both wings black: beneath just as above, except that there is a row of fourteen white spots arranged in pairs round the outer margin of the anterior wings, and eleven similarly placed round the margin of the posterior wings, and also one near the apical angle between the costal and subcostal nervures.

Hab. Calobre, Veragua (*Arcé*).

Obs. A true *Olyras*, but differing from both known members of the genus in having the intervals between the black markings of the wings either transparent or clouded with a semitransparent yellowish tinge.

2. *Ithomia frater.*

♂. Exp. 2·50 in. Wings diaphanous: head, body (except

* All the specimens from which these descriptions are taken are in Mr. Godman's and my own collection.

on the under surface, which is paler), antennæ, nervures, and a broad margin to both wings black, the latter having obsolete white spots on the outer margin; the abdominal margin of the hind wing has a yellow spot.

♀. Similar to the male, but rather larger, and the outer black margin of the hind wings broader.

Underside differs only from the upper in having the white submarginal spots more clearly defined.

Hab. Pozzuzo, East Peru (*Pearce*).

Obs. Like *Ithomia cæno*, Dby. & Hew., but differs as follows:—The angle the lower discoidal nervule makes with the median is more obtuse, the lower radial is emitted above the recurrent nervule, the yellow patch of the hind wings is more restricted, and the subcostal branches of the anterior wings are included in the black margin. On the underside the white spot at the base of the posterior wings of *I. cæno* is absent, and in the present species the under surface of the abdomen is dusky instead of bright yellow.

3. *Ithomia tricolor.*

♀. Exp. 2·60 in. Antennæ black, yellow at the tip; palpi black, with lateral streaks of white; head black, with white spots; thorax and abdomen black, the latter grey beneath; anterior wings dusky black, with diaphanous patches, one, indistinct, at the base of the cell, another, distinct, at the end, one between the first and second median branches, and a large patch beyond the cell divided by the subcostal and radial nervures: posterior wings tawny orange; costal and outer margin black; this black border is broader at the apical angle, where it almost includes a whitish spot at the end of the cell, and then tapers off at the anal angle: beneath as above, but rather paler; six white spots near the outer margin of both wings show through to the upperside; the base of the costa of the posterior wings is white, and a large white patch spreads over and outside the cell, with the origin of the second median branch as its centre: neuration of hind wing as in ♀ *Ith. cæno*; but the wing is more elongated, there is no upper discocellular, the upper radial appearing as a branch of the subcostal.

Hab. Apolobamba, North Bolivia (*Pearce*).

Obs. This species belongs to the group containing *Ithomia cæno*, and to the section *Ceratinia* of Bates's arrangement. It is, however, quite different in coloration from any species with which I am acquainted.

4. *Ithomia semifulva.*

♂. Exp. 2·60 in. Antennæ yellow, black at the base;

prothorax and wing-coverts tawny; abdomen brownish black, beneath yellow: anterior wings tawny, apical third, including the whole outer margin, two spots at the end of the cell, and the base of the wing, except along the subcostal and median nervures, brownish black: posterior wings black; apical angle, except the margin, tawny: beneath similar to the upper surface, except that there is a row of white spots close to the outer margin of both wings: costa of the hind wings tawny, the base yellow.

♀. Similar to the male.

Neuration similar to that of *Ith. dionæa*, Hew., and its allies.

Hab. Guadalquiza, Ecuador; and Pozzuzo, Peru (*Pearce*).

Obs. In coloration this species exactly resembles *Mechanitis mothone*, Hew., on the upperside, and only differs on the underside by the presence of the submarginal row of white spots. It belongs to the *Ceratinia* group of *Ithomia*, but is unlike any other species of this section.

5. *Ithomia pardalis.*

♂. Exp. 3·05 in. Head *wanting*; prothorax and abdomen black; anterior wings yellowish, diaphanous; outer margin, including a large triangular spot at the extremity of each of the nervures, black; there are two black spots joined by a narrow line at the end of the cell, and three semitransparent, elongated, dark spots between the subcostal, the radials, and the third median branch; inner margin black: posterior wings clear transparent, outer margin broadly black, deeply indented internally, including six round transparent spots; an irregular dark band crosses the wing through the end of the cell to the inner margin: the markings beneath as those above, but in addition there are two small white spots near the apex of the anterior wings, and two elongated white marks about the middle of the costa of the posterior wings, the base being yellowish. Neuration as in *Ithomia susiana*, Feld.; the lower discocellular makes an acute angle with the third section of the median; the middle discocellular bears the recurrent nervule, and the upper discocellular meets the subcostal at a very obtuse angle at a distance from the base of the wing about equal to the first and second sections of the median nervures.

Hab. Guadalquiza, Ecuador (*Pearce*).

Obs. Though differing in the much greater transparency of the wings, this species must certainly be placed near *Ith. susiana*, Feld., the neuration of the hind wing agreeing best with that species. The antennæ are wanting; but, from analogy, they should be long.

6. *Ithomia peruana.*

♂. Exp. 2·40 in. Antennæ black, the club yellow; palpi white, black in front; head and thorax black; abdomen black, dusky beneath: anterior wings diaphanous, the margins, nervures, and two dark bands, one across the middle and the other at the end of the cell, black; a small yellowish spot lies close to the costa beyond the cell: posterior wings diaphanous, the apical angle, nervures, and outer margin black; a yellowish tinge pervades the film near the inner margin: beneath as above, the dark borders of the wings having the inner part red; basal half of the costa of the posterior wings yellow; there are three small white spots close to the apical angle of the fore wings, and a row of five close to the outer margin of the hind wings: neuration of the hind wings as in *Ith. avella*, Hew.; the pencil of hairs originates from a receptacle formed by the curvature of the costal and subcostal nervures; the recurrent nervule is borne by the lower discocellular; the upper discocellular is long, and meets the subcostal some way from its extremity at a very obtuse angle.

Hab. Pozzuzo, East Peru (*Pearce*).

Obs. Allied to *Ith. avella*, Hew., but differs in the club of the antennæ being yellow instead of black, in the costal margin being quite black instead of rufous, and beneath in half of the costal margin of the posterior wings being yellow, and in the origin of the pencil of hairs being black instead of grey in the middle: the posterior wings, too, are tinged with yellow instead of being clear hyaline.

7. *Ithomia picta.*

♀. Exp. 2·15 in. Antennæ black, with the club yellow; palpi white, black in front; head, thorax, and abdomen black, the latter whitish beneath: anterior wings black, less opaque towards the outer half of the wing beyond the cell; anterior portion of the cell tawny, the end covered with a black patch; a large yellow spot in the middle; there are four irregular yellow spots outside the cell, the uppermost crossing the subcostal and upper radial, and a submarginal row of five yellow spots; posterior wings bordered broadly with black, next to which is placed a tawny band extending over the inner margin, but not to the apical angle; inside the tawny colouring is a large yellow patch including the whole of the cell and extending beyond it: beneath as above, the base of the costa of the posterior wings being tawny; and the outer marginal black band of each wing includes seven white spots. Neuration of hind wing as in ♀ *Ith. latilla*, Hew. The lower discocellular emits

the recurrent nervule, and there is a very short upper discocellular nervure.

Hab. New Granada.

8. *Ithomia cayana.*

♂. Exp. 2·05 in. Antennæ moderately long, black; palpi white, black anteriorly; head black, with a white frontal spot; prothorax black, with a yellow spot on each side; thorax black, with a yellowish central streak; abdomen black above, yellow beneath: anterior wings semidiaphanous, brown, cell almost to the end tawny; an irregular pale yellow spot extends almost from the costa over the upper discocellular nervure and the corner of the cell, and thence over the third median branch; between the first and second median branch is another smaller yellowish spot; these yellow spots leave an irregular dark band, which crosses the end of the cell to the posterior angle: posterior wings tawny; a semidiaphanous brown band crosses the wing, and another skirts the outer margin: beneath as above; base of the costa of the fore wing tawny, seven conspicuous submarginal white spots surround the outer margin, and show through to the upper surface: on the hind wing there are five similar spots: neuration of the hind wing somewhat as in *Ith. antisao*, Bates; the lower discocellular is straight, middle discocellular bent at the emission of the recurrent nervule, and then curved outwardly to the subcostal; upper discocellular absent; upper radial starts as a branch of the subcostal a little beyond the end of the cell.

♀. Like the male; nor does the neuration of the posterior wing differ materially, the only distinction being that the middle discocellular meets the subcostal at a more acute angle and at a shorter distance from the base of the wing.

Hab. Cayenne.

Obs. This species seems to have been overlooked amongst specimens of *Ith. selene*, Cr., to which it bears a great resemblance. The distinct row of white spots at once distinguishes the species, and a comparison of the neuration shows that the two are perfectly distinct, and do not even belong to the same section of the genus. *Ithomia cayana* is quite common in cabinets, having been sent in considerable numbers in recent collections from Cayenne. Its nearest structural allies are *Ith. antisao*, Bates, and its affines which have the upper radial as a branch of the subcostal of the hind wing. The present species, however, differs in that the middle discocellular bears the recurrent nervule instead of the lower.

9. *Ithomia rufocincta.*

♂. Exp. 2·30 in. Antennæ black; palpi white, black to-

wards the terminal joint; head black, with white spots; prothorax rufous; thorax rufous; abdomen black, whitish beneath: wings diaphanous, bordered with clear rufous; nervures and end of the cell of the anterior wings rufous; space between the median and submedian nervures of the anterior wings and margin near the anal angle of the posterior wings blackish: beneath as above, but margins paler; costa of posterior wings and spots at the apices of both wings pale greyish: neuration of hind wings as in *Ith. artena*, Hew.; lower discocellular bent to a right angle at the emission of the recurrent nervule; middle discocellular gradually curved outwardly to meet the subcostal; no upper discocellular, nor upper radial.

Hab. Oaxaca, Mexico.

10. *Ithomia simplex.*

♂. Exp. 2·15 in. Antennæ black; palpi white, black anteriorly; head black, with white spots; prothorax and thorax greyish black; abdomen black, whitish beneath: wings diaphanous; nervures, a narrow line at the extremity of the cell of the anterior wings, and a narrow margin round both wings black; subcostal to the end of the cell rufous; a white oblong spot close to the costa just beyond the end of the cell: beneath as above, but with the markings rufous instead of black: neuration of hind wing the same as in *Ith. artena*, Hew.; lower discocellular bent to a right angle close to the origin of the lower radial; middle discocellular gradually curved to meet the subcostal; upper discocellular entirely wanting, as also the upper radial.

♀. Like the ♂, but the margins rather more broadly black; neuration of the hind wing like that of *Ith. artena*, Hew.; upper discocellular nervure absent; upper radial leaves the middle discocellular at its junction with the subcostal.

Hab. Costa Rica (*Carmiol*).

Obs. Very nearly allied to *Ith. artena*, differing chiefly in the narrower borders to the wings and the smaller size of the white spot on the anterior wings.

11. *Ithomia parva.*

♂. Exp. 1·80 in. Antennæ black; anterior wings diaphanous, the end of the cell, the nervures, and the borders of the whole of the wing-margins black; next to the black spot at the end of the cell is a white streak extending almost from the costa, over the radials, nearly to the third median branch: posterior wings diaphanous, the nervures and border of the outer margin black; beneath the markings are rufous instead of black, and

there are three small spots close to the apex of the anterior wings: neuration of hind wings as in *Ithomia cotytto*, Guér.; the lower discocellular is bent to an acute angle where a short recurrent nervule is emitted; the middle discocellular is gradually curved to meet the subcostal: both upper discocellular and upper radial are absent.

Hab. Costa Rica (*Carmiol*).

Obs. Allied to *I. cotytto*, but the inner edge of the black border of the apex follows the curve of the wing, instead of cutting straight across. It is also considerably smaller.

12. *Ithomia vicina.*

♂. Exp. 2·25 in. Antennæ black; palpi white, black anteriorly; head and prothorax black, with white spots; thorax black, with a central white streak; abdomen brownish black, whitish beneath: anterior wings rather broad, rounded, diaphanous, costal margin rufous; a pointed streak across the middle of the cell, and an irregular triangular patch at the extremity of the cell, brownish black, apex and outer margin with an irregular rufous border, narrower between the extremities of the radials and between the second and third median branches; a white oblong spot close to the costa, beyond the extremity of the cell, including a portion of the upper radial near its origin; inner margin black as far as the median nervure and its first branch: outer margin of posterior wings rufous, bordered with black, nervures black; there are whitish transparent spots near the marginal border of both wings, except between the third median branch and the lower radial: beneath as above, the dark markings of both wings being lighter rufous: neuration of hind wings as in *I. zea*, Hew., to which this species is closely allied; lower discocellular long and abruptly bent to an acute angle at the emission of the recurrent nervule; middle discocellular long and curved parallel to the subcostal; upper discocellular moderate, meeting the subcostal at a slightly obtuse angle close to the apical angle of the wing.

Hab. Costa Rica (*Carmiol*).

Obs. Very closely allied to *Ithomia zea*, Hew., but differs in being smaller and principally in having the markings at the apex of the anterior wings smaller, leaving the wing more transparent; the spot at the end of the cell is triangular instead of quadrate, and the mark across the cell more acute and nearer the body.

13. *Ithomia lyra.*

♂. Exp. 2·40 in. Antennæ black; palpi white, with the ter-

minal joint black; head and prothorax black, with white spots; thorax black, with a white central streak; abdomen black above, whitish beneath: anterior wings diaphanous, costal and inner margins black; a black oblong spot covers the end of the cell; outer margin black, deeply sinuated along its inner edge, with semitransparent white spots in the sinuses; a white mark extends from the costa beyond the cell, over the radials to the third median branch; nervures black: posterior wings diaphanous, nervures and border of outer margin black: beneath as above, the dark markings of the upperside being fulvous instead of black: neuration of hind wing as in *Ith. andromica*, Hew.; lower discocellular atrophied at the extremity; middle discocellular appears as a projection at the junction of the upper discocellular and upper radial; the latter are stout and well defined, the upper radial anchylosing with the subcostal close to the margin of the wing; the lower radial is isolated and disconnected, appearing only towards the margin of the wing.

♀. Like the male, but the dark markings rather broader, and the apical portion of the anterior wings more clouded, but leaving two clear spots: neuration of the posterior wing as in ♀ *Ithomia andromica*; the middle discocellular nervule is absent, the upper and lower radials combine and then branch into a fork halfway towards the margin of the wing.

Hab. Valley of the Polochic River, Guatemala; Calobre, Veragua (*Arcé*); Costa Rica (*Carmiol*).

Obs. Closely allied in structure and coloration to *I. andromica*, but differs in being larger, the anterior wings being less produced and wider, and the dark markings and borders being broader, and the white patch of the anterior wings narrower.

14. *Eresia nigripennis.*

♂. Exp. 2·45 in. Antennæ black, the club yellow; palpi black, white on each side; head and thorax black; abdomen brown, with a black line above and below: anterior wings produced, apical angle rounded, black, with two series of indistinct spots beyond the cell yellow; there is also a yellow spot between the first and second median branches: posterior wings tawny red, costal and outer margins black, two tawny spots at the apical angle; cilia of both wings white between the nervures: anterior wings beneath tawny at the base on each side of the median nervure, running into yellow between the first and second median branches; a series of eight yellow spots round the outer margin, those in the apical angle elongated and extending to the margin; another series of elongated spots between these and the end of the cell: posterior wings

tawny red, paler in the centre; a black line follows the subcostal, and then forms a border to the outer margin, and includes two white spots at the apical angle, followed by a row of lunules along the marginal border; base of the costa yellow.

Hab. Costa Rica (*Carmiol*).

Obs. This species is rather like *E. phillyra*, Hew., in form, the apical portion of the anterior wings being broader, and the outer margin of the hind wings more rounded. In colour it differs in the anterior wings being almost quite black, and in the absence of the black band across the hind wings.

15. *Eresia actinote.*

♂. Exp. 2·25 in. Antennæ, head, thorax, and abdomen black, the latter greyish white beneath: anterior wings black, with a triangular patch including the cell and extending along the submedian nervure to the posterior angle, and an oval spot between the end of the cell and the apical angle tawny red: posterior wings black, with a central large patch of tawny red divided by the dark nervures: beneath as above; but the extremities of the oval spot of the anterior wings are yellowish, and a tawny-red submarginal line runs round the outer margin: posterior wings beneath dull brownish, yellowish at the base, with nervures black; outer margin broadly black, with a narrow tawny-red submarginal line.

Hab. Valley of the Cosnipata, East Peru (*H. Whitely*).

Obs. This species is most like *E. acræina*, Hew., of which Mr. Whitely has also sent examples; but, besides other minor differences, the narrow red submarginal line which surrounds the outer margin of the underside of both anterior and posterior wings is sufficient at once to distinguish it. Like *E. acræina*, it also bears a deceptive resemblance to some members of the genus *Acræa*.

16. *Eresia ithomiola.*

♂. Exp. 2·25 in. Antennæ yellow, black at the base; palpi black, yellowish white in front; head black; thorax black, with the wing-coverts tawny yellow; abdomen black, yellowish beneath: anterior wings rich tawny yellow, costa and terminal third black; a black elongated spot on the first segment of the median nervure, another at the end of the cell, and a third outside the third segment of the median nervure: posterior wings black, the apical angle tawny yellow, leaving three black marginal spots: beneath as above, the costa of the posterior wings tawny yellow, and the base yellow.

Hab. Valley of the Cosnipata, East Peru (*H. Whitely*).

Obs. The resemblance between this species and *Ithomia*

semifulva described above, which, though frequently sent in Andean collections, was not found by Mr. Whitely, is most striking. It belongs to the same group as *E. eunice*, Hübn., but is unlike in coloration any species I am acquainted with.

17. *Eresia pusilla.*

♂. Exp. 1·25 in. Like *E. ofella*, Hew., but differs in being much smaller, the anterior wings being less produced. A series of three white spots divide the costa of the anterior wings into four portions, the basal portion being the largest; the costa itself is dull black, like the wings. Under each of these spots is another larger spot, the innermost reaching to the inner margin: the white belt of the hind wings is narrower: beneath it differs chiefly in the arrangement of the white spots of the anterior wings, which are placed as above; the hind wings have a distinct submarginal lunate band.

Hab. Valley of the Cosnipata, East Peru (*H. Whitely*).

18. *Eunica chlororhoa.*

♂. Exp. 2·60 in. Antennæ long, black; palpi white; head, thorax, and abdomen black: wings black, the outer half of the posterior wings rich glossy green: beneath greenish grey variegated with black spots—one across the cell of the anterior wings, another transverse, with a bifurcation upwards at the end of the cell, another transverse, followed by two elongated spots beyond the cell, then an irregular narrow transverse spot, followed by four round ones placed transversely, then three more near the apical angle of the wing; below this series is a large black patch between the median nervure and its first and second branches, another between the second and third median branches, others beyond them again, and finally a large patch near the anal angle: on the posterior wings a tawny band stretches from the base of the wing over the inner half of the cell, and inwards almost to the abdominal margin; it is then confined between the third median branch and lower radial, spreading over the latter, however, as it approaches the outer margin. Above this band there is a black spot between the precostal and costal nervures, a series of four between the costal and subcostal; between the subcostal and upper radial are three round spots, with a transverse thick line between each of them; a similar series is shown between the upper and lower radials; in the cell are three conspicuous spots; below the tawny line and between the third and second median branches is a series of spots, as follows,—first a round one, then a cross line curved downwards, then a large spot followed by two others placed side by side, lastly a triangular spot

with the apex pointing inwards; between the second and first median branches is another exactly similar series, and between the first branch and the inner margin are six spots placed in pairs.

Hab. Valley of the Cosnipata, East Peru (*H. Whitely*).

Obs. Allied to *E. sophronisba* (Cr.), but very distinct, the outer portion of the posterior wings being green instead of blue, and the markings beneath much more clearly defined and differently arranged.

19. *Eunica elegans.*

♂. Exp. 2·65 in. Antennæ black, fulvous at the tip beneath; head, thorax, and abdomen black; prothorax brown: wings above brown, suffused with blue on the basal half: posterior wings rounded, slightly indented between the nervures, the cilia of both wings rather paler: beneath brown, the posterior wings paler, greyer, and rather lustrous: base of the anterior wings paler, a dark spot in the middle of the cell: apex of the anterior wings pale greyish, lighter next the outer margin, the light part bounded by an irregular faint dark line: on the posterior wings are a series of six nearly obsolete ocelli between the nervules, halfway between the cell and the outer margin; a series of V-shaped lunules follow these as a submarginal waved line; there is a dark border next the fringe; inside the lunules is a very irregular dark band passing across the wing from the middle of the costa, outside the cell, to the middle of the inner margin; there is also a black spot inside the cell, another across the opening, another (comma-shaped) between the subcostal and costal nervures, and, finally, one between the costal and the costa itself.

Hab. Apolobamba, North Bolivia (*Pearce*); Pozzuzo, Peru (*Pearce*); valley of the Cosnipata, Peru (*H. Whitely*).

Obs. Most nearly allied to *E. bechina*, Hew.; but the blue gloss of the wings is more restricted and darker; the anterior wings are broader and less pointed, and bear no white spots; the posterior wings are less produced; beneath, the markings of the posterior wings are rather more distinct, and there are no light spots in the dark portion of the anterior wings.

20. *Eunica tenebrosa.*

♂. Exp. 2·60 in. Antennæ black, rufous at the tip beneath; head, thorax, and abdomen black: wings rounded, dark brown, glossed with deep blue towards the base: there is a black patch of hair-like scales about the basal section of the subcostal nervure of the posterior wings: anterior wings beneath brown, the base, apex, and nervures paler; there are two dark marks

across the cell, and a black patch about the origin of the first median branch, two small spots and some irregular whitish marks near the apex of the wing: posterior wings rich brown, mingled here and there with a rufescent tinge; two small ocelli are placed between the radials, surrounded by a common ring; a dark curved line nearly touches this ring from the costa, and goes as far as the third branch of the submedian nervure, and thence to the inner margin by a series of waves; another curved line extends from the costal to the subcostal, and two dark marks cross the cell; near the anal angle and outer margin are three indistinct lunules; a waved line follows the outer margin.

Hab. Pozzuzo, East Peru (*Pearce*).

Obs. Near *Eunica caria*, Hew., but the anterior wings are much darker and the blue more diffused: beneath the markings are quite similar, but the light markings at the apical angle of the anterior wings are more numerous and extend further along the costa.

21. *Eunica brunnea.*

♂. Exp. 2·90 in. Antennæ black, with a row of white spots beneath; palpi brownish white, the third joint black above; head black; prothorax brown; thorax and abdomen black: anterior wings elongate, the outer margin concave, brown, purple at the base; the apical portion of the wing is paler, crossed by a dark band running from the costa to the middle of the outer margin: posterior wings brown, with a purple gloss towards the base, and an indistinct dark submarginal line surrounding the outer margin: beneath paler brown, the dark band of the upper surface more prominent; there is also a dark band beyond the cell extending to the posterior angle: posterior wings beneath with a bipupillate ocellus extending from the subcostal to the lower radial nervule; two other ocelli between the branches of the median nervules, that nearer the anal angle the larger; a dark submarginal line surrounds the outer margin; another line extends in a curve from the costal nervure downwards to the third branch of the median, and thence direct to the inner margin by a series of lunate marks; a curved line closes the cell, within which are a pair of small spots; a dark line also curves upwards from the first section of the subcostal to the costal nervure.

Hab. Valley of the Cosnipata, East Peru (*H. Whitely*).

Obs. Allied to *Eunica caralis*, Hew., but has less blue on the anterior wings, and the posterior wings are less produced at the anal angle: beneath, the markings of the posterior wings are quite different, and are well defined instead of being confused and indistinct.

22. *Cybdelis boliviana.*

♂. Exp. 2·20 in. Antennæ black, dotted with white, beneath brown; palpi brown above, grey beneath; head, thorax, and abdomen black, the latter lighter beneath: anterior wings with a notch on the outer margin, on each side of which, between the nervules, the cilia are white; dark glossy brown, a white spot with blue edging beyond the cell, another between the first and second median branches, one near the costa beyond the third subcostal branch, and a fourth near the apex, between the subcostal and upper radial; there are three small blue spots in the cell, another close to the costa, and two more between the end of the cell and middle of the outer margin: posterior wings produced at the anal angle, dark brown, with a large central blue patch; outer margin nearest the anal angle and submarginal line black; cilia nearest the apical angle white: base of the anterior wings beneath pale reddish, with a ruddy spot within the cell, apex whitish, variegated with dusky: posterior wings tinged with lilac and variegated with brown scales; an irregular brown band crosses the cell, another, much broken, crosses the wing, with the general contour of the outer margin; five indistinct ocelli beyond the cell, and a submarginal line of lunules parallel to the outer margin, the apical portion of which is whitish, the anal portion brown.

Hab. Apolobamba, North Bolivia (*Pearce*).

Obs. Allied to *C. mnasylus*, Dby., but is larger and darker, with the central spot of the hind wings blue instead of white in the middle, and the markings of the under surface more distinct.

Mr. Pearce brought several specimens of this species, all agreeing with one another.

23. *Perisama hilara.*

♂. Exp. 1·85 in. Antennæ black, club fulvous beneath; palpi white at the base, the terminal joint being black; head, thorax, and abdomen black, the latter greyish white beneath: anterior wings black, a line within the cell lying close to the median nervure, and passing out to between the first and second median branches, a broad patch extending from between the second and third median branches to the posterior angle, an oblique spot beyond the cell and another near the apical angle shiny metallic greenish blue; cilia of the outer margin white between the nervures: posterior wings black, cilia white; a submarginal band of metallic blue divided by the nervules extends from the submedian nervure to the end of the upper radial: basal half of the anterior wings beneath crimson (except along the costa and the base itself, which are grey); apex of the wing grey sprinkled with black scales, between this and

the crimson black, on which near the costa is a white spot followed by a blue dash: posterior wings cinereous, costa red; a very irregular narrow black band crosses the wings from the costal to the inner margin, and a lunulated submarginal band skirts the outer margin; between the radials are two very indistinct black spots, about which and towards the costa is a brownish cloud.

Hab. Valley of the Cosnipata, Peru (*Whitely*).

Obs. In the markings of the upper surface this species resembles *Perisama Lebasii*, Guér.; on the underside it differs in the greater extent of crimson on the anterior wings, in the much greater irregularity of the inner dark line of the posterior wings, and in having the black spots scarcely traceable.

24. *Callicore neglecta.*

♂. Exp. 1·80 in. Antennæ black; palpi black above, white beneath; head black; thorax tinged with green; abdomen black above, beneath white: wings blue-black, cilia white; base of the wing sprinkled with shining blue scales; a blue or golden-green band crosses the anterior wing from the subcostal to the inner margin near the anal angle; another band of the same colour, followed outwardly by another narrow duller line, occupies the middle of the posterior wing near the outer margin: base of the wing beneath, apex, and outer margin white, central portion crimson, the rest black; a narrow black line follows the outer border, and another parallel to it skirts the apical angle: posterior wings white; a narrow submarginal line, two lines parallel to the outer margin coalescing in a red costal line, black; two black central rings, one (pear-shaped) including one black spot, the other (oval) including two spots; two other black lines cross the base of the wing, and follow down the inner margin.

Hab. Apolobamba, North Bolivia (*Pearce*); valley of the Cosnipata (*Whitely*); Pozzuzo, Peru (*Pearce*); Ecuador; New Granada; central valleys of Guatemala (*Salvin & Godman*).

Obs. Most nearly allied to *C. anna*, Guér., but differing in having a double band to the hind wings, the upper one of the same lustre as that of the anterior wings. *C. clymena*, with which this species is usually placed in collections, has but a single dull-coloured band, and beneath is distinguished for the great size and width of the black markings.

The species, as will be seen from the above list of localities, has a wide range in the valleys of the Andes, thence extending northwards into Central America as far as Guatemala.

25. *Catagramma titania.*

♂. Exp. 2·25 in. Antennæ black; palpi black, anteriorly white; head black, with small white spots near the origin of the antennæ; prothorax black; thorax and wing-lappets brown; abdomen black: anterior wings crimson on the basal portion, the inner margin, costa, and apical portion black glossed with deep blue; there are three reddish spots near the apex of the wing: posterior wings black, glossed in the centre with deep blue; brownish hair-like scales cover the basal portion; the anal angle is slightly prominent, and the cilia between the nervures are white: beneath, anterior wings as above, but paler, and the black portions without the blue gloss; a yellow band crosses the apical angle, cut near the outer margin by a submarginal blue band, which follows the bend of the same angle: the posterior wings have an irregular oval yellow ring enclosing two pairs of blue spots divided by a yellow line; yellow lines extend along the costa, over the submedian nervure, and parallel with the inner margin between these and the oval ring is another yellow line; crossing the wing outside the ring, and following its curve, is a broad blue line, and between this and the outer margin a yellow band, which, however, does not turn the anal angle.

♀. Similar to the male, but larger, the anterior wings less pointed and rounder; a yellow streak crosses the apical angle.

Hab. Borders of the forests of Guatemala, on both the Atlantic and Pacific sides of the cordillera.

Obs. This species is very closely allied to the Amazonian species described by Mr. Hewitson as *C. maimuma*; but I have seen so very many specimens, none of which quite correspond with South-American examples, but which agree most closely with one another, that I am satisfied the two species can always be distinguished. There is a wide gap between the ranges of *C. maimuma* and *C. titania*; the latter, though abundant in Guatemala, and ranging, I believe, as far south as Nicaragua, has not yet been taken anywhere southwards of this point; the former has not yet been met with beyond the districts bordering the Upper Amazon and its affluents, and even there seems to be a scarce species. The most noticeable differences between the two are as follows: in *C. titania* the crimson patch of the upper wings is more restricted, and the dark parts glossed with blue, the anal angle of the posterior wings is more produced, and the patch of blue more widely diffused; on the underside the yellow lines are constantly narrower.

26. *Catagramma casta.*

♂. Exp. 2·25 in. Antennæ black; palpi black, with a lateral white streak; head black, with two frontal spots, three on each side near the origin of the antennæ, and a streak behind the eye white; prothorax and thorax black; abdomen black, with a yellow streak beneath; front legs black, with the extremity and a streak on the outside of the tibia white: anterior wings broad, but somewhat obtusely pointed at the apex, deep glossy blue, except at the apical angle, which is black; rather nearer the apex than the extremity of the cell is a small yellow band consisting of three spots divided by the radial nervures: posterior wings rounded, the anal angle hardly projecting, deep glossy blue, rather brighter round the outer margin; cilia between the nervules white: anterior wings beneath black, base of the costa yellow; the yellow band of the upperside is much longer, extending from the costa to the second median branch; a crimson patch covers the entire cell and basal portion of the wing from the centre of the inner margin; a blue submarginal line follows the bend of the apical angle: posterior wings black, an indistinct oval yellow ring in the central portion of the wing includes three bluish spots, with a yellow dash between them; on the basal side of this ring is another, broader yellow line reaching from the costa towards the inner margin; outside the ring is a series of eight light-blue linear spots crossing the interspaces between the nervures from the costa to the inner margin; a narrow yellow submarginal line follows the outer edge.

Hab. Eastern slope of the mountains of Oaxaca, Mexico, at an elevation of about 3000 feet.

Obs. A beautiful species, belonging to the *C. maimuna* group, but differing from all its congeners by its colouring above, which is uniform deep glossy blue varied only by the small yellow spots near the apex of the anterior wings.

27. *Epicalia regina.*

♂. Exp. 2·90 in. Antennæ black; palpi green in front, the terminal joint black above; head and thorax black, prothorax dark brown; abdomen black above, greenish beneath: wings deep black, a broad band across the anterior wings from the costa, past the end of the cell, to the first median branch, a small transverse band consisting of three spots, and the apex of the posterior wings blue, as in *Ep. ancea*; there is a small red spot near the anal angle of the hind wings: beneath grass-green, the bands of the upperside much paler, almost white; there is a dark spot in the cell followed by two cross lines,

also a dark mark outside the light cross band near the outer margin: on the posterior wings a narrow dark waved line, the main direction being nearly straight, crosses the wing from the middle of the costa, past the end of the cell, towards the inner margin; another short broken line passes from the costal nervure to the middle of the cell; there are four spots between the cross line and the outer margin, the innermost black and white, the middle ones white, and the uppermost black, with a few tawny scales on its inner side; a very faint submarginal line follows the curve of the outer edge.

♀. Similar to the male, but browner, and has two red marks within the cell, a dark submarginal line on the posterior wings, inside of which are four black spots, that nearest the anal angle bearing a blue pupilla.

Hab. Caraccas, Venezuela (*A. Goering*).

Obs. Allied to *E. aglaura*, Dby., but without any tawny colouring on the posterior wings; apex of the posterior wing greenish blue, as in *E. Hewitsoni*, Feld.

28. *Callithea Whitelyi.*

♂. Exp. 2·55 in. Antennæ black; palpi grey in front; head and prothorax black, thorax and abdomen tinged with dark blue: wings rich glossy blue, rather darker towards the base; costa and apex of the anterior wings black; a broad curved green band crosses the wing at its widest part to the anal angle: a band of the same colour borders the outer margin of the posterior wing; the margin itself is black, and the cilia white: beneath bronzy green, the base only of both wings red: there are four black spots near the outer margin of the anterior wings: four rows of black spots follow the curve of the outer margin of the hind wing; the innermost passes just outside the cell, and consists chiefly of rather elongate triangular spots; in the next the spots are almost circular; in the next the spots become lineiform towards the inner margin; in the outermost the spots are lunate.

Hab. Valley of the Cosnipata (*H. Whitely*).

29. *Paphia lineata.*

♂. Exp. 2·90 in. Antennæ and head *wanting*; thorax and abdomen greenish black: anterior wings considerably produced at the apical and strongly falcate at the anal angle, outer margin slightly concave, very dark green; base of the wing, a series of six spots arranged across the apical angle and thence down the outer margin, and the whole of the posterior wings green: posterior wings show a notch, but are without caudal appendage: beneath glossy brown freckled with

white and darker brown; a dark band crosses from the apical angle of the anterior wings to the second section of the median nervure of the posterior wings; another reaches from the apical angle of the hind wings to the inner margin; and a third, parallel to the last, forms a chord to a portion of the curve of the outer margin, near which are four very small white spots.

Hab. Apolobamba, North Bolivia (*Pearce*).

Obs. The markings of the underside of this species correspond with those of *P. leuctra*; on the upperside it resembles *P. mæris*, Feld., without the caudal appendages.

30. *Paphia indigotica.*

♂. Exp. 3·30 in. Antennæ black; palpi brown, freckled with white; head and thorax dark greenish; abdomen dark indigo-blue: anterior wings have the apical angle pointed, the outer margin straight to the bend of the anal angle, which is only slightly falcate; dark indigo-blue, lighter at the base; costa freckled with pale bluish-green scales; a curved band of pale bluish green crosses the apical angle from the costa to the outer margin, the posterior wings, which are dark indigo-blue, being bordered with the same colour: posterior wings with a simple caudal projection: beneath rich reddish brown, freckled, especially near the costa of the anterior wings, with white; a darkish band crosses the cell, another starts from the middle of the lower radial, and reaches to the second section of the median nervure of the posterior wings; another band crosses the posterior wings from the apical angle to the inner margin; and another, parallel to the last, forms a chord to part of the outer margin; outside this last band is a broad whitish line, and near the base of the caudal projection a spot outwardly black, inwardly white.

Hab. Calobre, Veragua (*Arcé*).

Obs. Closely allied to *P. chæronea*, Feld., but much darker blue, *P. chæronea* being green rather than blue. The band across the apex of the anterior wings is less distinct.

31. *Paphia zelica.*

♀. Exp. 3·10 in. Antennæ black; palpi brown, freckled with white scales; head and thorax greenish; abdomen dusky: anterior wings slightly acute, outer margin slightly convex, anal angle strongly falcate; dark purple brown; a broad tawny band, slightly curved, crosses the wing beyond the cell from the costa to the anal angle, but does not extend over the hook: posterior wings deep purple brown, with long, slightly spatulate caudal appendage; anal angle *mutilated*, apical angle tawny:

beneath brown, rather paler where the cross band on the upperside of the anterior wings is situated, freckled with darker and white spots, the latter chiefly along the costa of the anterior wings, across the cell of which are two dark bands, the innermost of which extends over the cell of the hind wings; a dark band also crosses both wings from the middle of the upper radial of the anterior to the second section of the median nervure of the posterior wings; there are also two parallel transverse cross bands on the lower wings, the uppermost reaching from the apical angle to the inner margin.

Hab. Calobre, Veragua (*Arcé*).

Obs. Near to *Paphia xenica*, Bates, from Guatemala; but the base of both wings is rich purple instead of greenish, and the markings of the underside are much more distinct.

32. *Paphia proserpina.*

♂. Exp. 3·40 in. Antennæ black; palpi with a central black line laterally freckled with white scales; head, thorax, and abdomen greenish black: anterior wings slightly acute, outer margin slightly concave, anal angle falcate; very dark indigo-blue, lighter and greener at the base of both wings; near the apical angle of the anterior wings are three faint bluish spots, and the outer margin of the hind wings is similarly coloured: the posterior wings bear a notch, but are without caudal appendage: beneath rich ruddy brown, sparingly marked with white scales; there are three very indistinct white spots between the end of the third median branch and the anal angle of the posterior wings.

♀. Exp. 3·80 in. Base of both wings and a conspicuous patch consisting of three spots near the apical angle of the anterior wings blue: posterior wings with caudal projection: beneath ruddy brown, paler than in ♂, and freckled more strongly with white and dark marks, especially on the costa of the anterior wings; between the outer margin and the extremity of the lower radial are five white spots, each with a smaller black spot on its outer edge; the caudal projection and the part adjoining are irrorated with black and white.

Hab. Valley of the Rio Polochic, Guatemala.

Obs. This is a large showy species, not nearly allied to any with which I am acquainted.

[To be continued.]

XX.—*On a new Labyrinthodont Amphibian from the Northumberland Coal-field, and on the occurrence in the same locality of* Anthracosaurus Russelli. By ALBANY HANCOCK, F.L.S., and THOS. ATTHEY.

WE have recently obtained from the black shale associated with the Low-main seam at Newsham Colliery, in the neighbourhood of Newcastle-upon-Tyne, the remains of a small amphibian belonging to Prof. Huxley's genus *Urocordylus**. This is the second generic form that has occurred to us in this locality of the interesting series described by that learned palæontologist from the Jarrow Colliery, in the county of Kilkenny, Ireland. We propose to name this species *Urocordylus reticulatus*. We have adopted the specific denomination *reticulatus* as expressive of the reticulated structure of the surface of the cranial bones. The specimen now before us is composed of the head and twenty-three or twenty-four vertebræ in a continuous series; the dorsal aspect of the head is exposed to view, and the vertebræ lie with their left sides uppermost. The entire length of the specimen is 2¼ inches. The head, which is much crushed and injured by the fracture of the bones, is of a subtriangular form, with the posterior region truncated, and tapering in front to a short rounded snout; and there are two large curved horns projecting backwards from the occipital region, like those of *Keraterpeton*†. In Prof. Huxley's species, the horns were not observed; but this is not to be wondered at, for the head was in a very bad state of preservation. In our specimen, too, the bones are so much broken up that it is impossible to determine their forms; the surface, however, of several of them is in excellent condition, and exhibits, in the most distinct manner, a coarse reticulated structure of elevated ridges or lines, which, from the elongation of the meshes in some of the bones, have the appearance of strong, raised, parallel striæ. The head measures from the snout to the occipital margin $\frac{4}{10}$ in., in width at the broadest part $\frac{5}{10}$ in.; the horns are $\frac{2}{10}$ in. in length.

Two or three teeth are distinguishable in one of the mandibles, but are somewhat injured; they are small, have the sides nearly parallel, and are slightly curved; the apices are apparently abruptly pointed. The sternal plates are distinctly displayed, but are in a much disturbed condition; all the three, however, can be made out, two of them being much

* "On a Collection of Fossil Vertebrata from the Jarrow Colliery, County of Kilkenny, Ireland," by Thos. H. Huxley and E. Perceval Wright (Trans. Royal Irish Academy, 1867, vol. xxiv.).

† See *op. cit.*

mutilated. They lie immediately behind the head, at the left side of the specimen, towards the ventral aspect; two are a little in advance of the third. They all have the surface covered with a minute reticulation of raised lines, which assume a radial disposition, as if from centres of growth. Behind the plates, on the left or ventral side of the body, there is a sort of roll, as it were, extending some way backwards, which seems to be composed of minute elliptical scales; they are, however, very indefinite; their exact form could not be determined.

The vertebræ, of which there are twenty-three or twenty-four, are very apparent, but their precise form is rather difficult to make out; they are nevertheless in regular order, but are somewhat obscured by the matrix. They each bear a long, compressed or flattened, plate-like dorsal spine, which is as high or a little higher than the centrum; its dorsal or free margin is truncated and serrated; below it is contracted in the antero-posterior direction, and, expanding above, somewhat resembles a fan, the resemblance being heightened by the strong radiating striæ that cover the sides. They are very similar to the vertical processes of *Urocordylus Wandesfordii*, but more particularly agree, in proportion and character, with the subvertebral bone or spine. The three or four terminal posterior vertebræ have in addition subvertebral bones similar in form and size to the dorsal spines. From this fact it would appear that these three or four vertebræ belong to the tail; and if the new species is as rich in caudal vertebræ as *U. Wandesfordii*, our specimen must have lost at least seventy of the bones of its tail. *U. reticulatus* has therefore about twenty trunk or precaudal vertebræ, the number that is found in Prof. Huxley's species. The vertebræ are about $\frac{1}{10}$ inch in length, and in height $\frac{1}{8}$ inch, including the dorsal spine; the height of the caudal vertebræ, measuring from the upper margin of the dorsal spine to the lower margin of the subvertebral bone, is $\frac{1}{4}$ inch. The zygapophyses project laterally as well as forward and backward.

There are slight indications of anterior and posterior limbs; but the appearances are too vague to be worthy of further notice, beyond that a fragment of bone seems to mark the place of the posterior limb near the termination of the trunk-vertebræ. And not far from this point there is also a small bone, which is probably one of the phalanges.

The length of the specimen, including the head and trunk-vertebræ, is only one-fourth that of the same parts of *U. Wandesfordii*; we may therefore conclude that the latter species is four times the size of *U. reticulatus*. When perfect,

U. Wandesfordii is upwards of 18 inches long; consequently the new species would measure 4½ inches if entire.

U. reticulatus is evidently closely related to *Keraterpeton*, as is proved by the form of the head, the two occipital cornua, and also by the character of the sternal plates; so close, indeed, does this relationship appear to be, that we have some doubt whether it should not be placed in that genus. It is true that no occipital horns were observed in *U. Wandesfordii*; but the skull of Prof. Huxley's specimen was so much crushed and disturbed that much stress cannot be placed on this negative fact; and the vertebræ of our species resemble more closely those of *Urocordylus* than they do those of *Keraterpeton*. Moreover in the latter form there is a perceptible diminution in the size of the nineteenth vertebra, and so on to the tail, while in our species the last of the three caudal vertebræ, the twenty-third or twenty-fourth, is as large as any of the trunk-vertebræ, agreeing in this respect with *Urocordylus*, and signifying that *U. reticulatus* has a long and powerful tail, which is the characteristic feature of the genus. We have therefore provisionally placed our new species in that genus.

Another question arises, Is *U. reticulatus* a distinct species? or is it merely the young of *U. Wandesfordii*? We believe it to be distinct, because the vertical processes of the vertebræ, though strongly resembling those of that species, differ considerably from them in certain particulars. The character of the sternal plates is also different, and the surface-structure of the cranial bones is apparently peculiar; but it must be allowed that this feature may be wanting in *U. Wandesfordii* merely on account of the curious state of preservation of the specimen from which that species was described. But be this as it may, the interest of this discovery is not lessened; and, indeed, this addition to the coal-fauna of the district is the most important that has been made since our acquisition in 1867 of *Ophiderpeton*, another of Prof. Huxley's genera from the Kilkenny coal-shales. And we cannot but deem ourselves fortunate in having met with this new species of so rare a form of Labyrinthodont Amphibian; for much novelty is not now to be expected from the shales of Newsham and Cramlington, which have been assiduously searched for the last fifteen years.

Anthracosaurus Russelli, Huxley.

A large fragment of the skull of this rare fossil was obtained a short time ago at Newsham; it is a portion of the anterior part of the cranium, and happily exhibits characteristic features that cannot well be mistaken. The snout is wanting, being

broken off diagonally backwards from left to right; and posteriorly the specimen is broken away in a parallel diagonal line a little behind the great vomerine tusks; so that on the right side nearly the whole of the maxilla is present; on the left the fracture passes close to the base of the large vomerine tusk, consequently the maxilla of this side is almost entirely wanting. In form the specimen is rhomboidal, being diagonally broken across before and behind; the sides are perfect; it measures lengthwise $3\frac{1}{2}$ inches, in breadth 6 inches.

Both the dorsal and palatal surfaces have been cleared of the matrix, a work of much care and labour; and though the parts are crushed and distorted, many of the characters are well preserved. The sculpture of the bone on the dorsal surface is distinctly displayed, and is of the usual Labyrinthodont character, resembling very closely that of *Pteroplax*; but the pits or depressions are less regular, and the surrounding ridges are rough and much broken up. The frontal bones are broken away before and behind, but the greater part of them is evidently present; they are considerably elongated, and are a little expanded in front. A triangular bone, with its apex forward, is interposed on either side between the frontals and the maxillæ; these bones are probably the postfrontals, or they may be the prefrontals and the postfrontals in combination. On the left side a fragment, probably of the nasal bone, is wedged in in front, between the anterior extremity of the frontal and the maxilla. The sutures are represented by wide, smooth, depressed lines, but, with the exception of those of the frontals, they are not very easily determined.

The other side of the specimen exhibits the roof of the mouth, but the bones are so much crushed and broken that it is impossible to make out their forms and limits. Suffice it to say that, a little in front of the great vomerine tusks, there is, on each side, a large deep depression (which two depressions are undoubtedly the anterior palatal foramina), and that immediately behind and towards the outer margin of the right vomerine tusk a circular depression, upwards of half an inch in diameter, indicates the position of the right posterior naris.

The teeth belonging to the fragment are nearly all present; but many of them are broken down and displaced, and only a few retain their apices. The two great vomerine tusks are not much disturbed; that on the right side stands erect, but a large portion of the crown has disappeared. It is placed somewhat nearer to the maxilla than to the central line of the skull, and is not very far from the anterior margin of the specimen; what remains of it is $\frac{5}{8}$ inch in height, and it measures across the widest part of the base $\frac{7}{8}$ inch. The left vomerine

tusk is crushed down close to the posterior margin of the specimen, with its base near its proper position, not far from the maxilla, and the apex pointing inwards: it is broken across near to the middle; and the basal portion overlies, to some extent, the upper part. When perfect, this tusk could not be less than two inches long, and is about an inch wide at the base.

Four teeth, upwards of half an inch long, lie upon the base of this large tusk, and another, about the same size, lies pressed down a little in front of it; these have their bases attached to the maxilla, and are the only maxillary teeth of this side, a very small portion of the maxilla being present. In front of these teeth a short space intervenes between them and the base of a large tooth, which stands erect, and is $\frac{3}{8}$ inch in diameter; the crown lies pressed down in contact with the basal portion, and with it measures nearly an inch in length. A large depression is immediately in advance of this tooth, separating it from two other teeth equally large, or, perhaps, a little larger, which are crushed down confusedly, one over the other, at the anterior extremity of the specimen. These three large teeth would seem to belong to the præmaxilla. The teeth of the maxilla of the right side are well displayed; they stand up, for the most part arranged along the alveolar ridge with their crowns (some of which are perfect) inclined backward and inward. There are thirteen of these teeth; they vary somewhat in size, and commence in front in a line with the base of the vomerine tusk. The first seven are placed close together; the first and seventh are larger than the rest, and are $\frac{1}{4}$ inch wide at the base; two or three of the smaller have the crown complete; when perfect, the large ones must have been upwards of half an inch long. A short space now intervenes in the series, and then there is a cluster of four more teeth, three of which are rather large and one small, the latter being placed between the first and second of the three; all their crowns are broken off; the bases of the three larger measure $\frac{1}{4}$ inch in diameter. Behind these is a large depression; and then the series is terminated by the two last teeth, the twelfth and thirteenth, which are placed near to each other. All that remains of the former is a very short stump, almost $\frac{1}{4}$ inch in diameter; the latter is apparently quite small, and is represented by a mere fragment, which is placed close to the fractured margin of the specimen.

In number and size the teeth do not exactly correspond to those of the specimen from the Lanarkshire coal-field described by Prof. Huxley*; but the disparity in these respects does

* Journal of the Geological Soc. vol. xix. p. 56, 1863.

not amount to much. In the Scotch specimen there are thirteen teeth described in the left præmaxilla and maxilla, while nineteen are enumerated as attached to the same bones of the right side. In our specimen there are thirteen maxillary teeth on the right side and three præmaxillary teeth on the left, one or two apparently being wanting. So it would seem that the Newsham specimen, when perfect, had, in all probability, sixteen or seventeen teeth in the upper jaw on each side; but as the number in the two sides does not apparently agree in the Scotch specimen, our specimen may have had two or three teeth more or less on either side, thus altering the number to thirteen or nineteen, as in the specimen described by Prof. Huxley.

The palatal teeth, however, are wanting in the Newsham specimen. On the left side, the bone to which they are attached is broken away; but on the right side there is a ridge behind the vomerine tusk, which, perhaps, may be the alveolar plate; if so, the teeth have been removed; there are, however, some fragments in the vicinity, which possibly belong to the palatal teeth of this side.

The teeth on the whole are somewhat less than those of the Scotch specimen, and this disagreement cannot be accounted for by the difference in size of the skulls. The Scotch skull is 5·3 inches in width opposite the vomerine tusks. Our specimen measures across the same region 5·5 inches; so the latter would appear to be the larger of the two. But this is probably not the case, for our fragment seems to be a little widened by pressure. The skull, however, of our specimen, when perfect, could not be much, if at all, smaller than that described from Scotland, which is stated to be 15 inches long, and 12 inches wide at the widest part. That they were of nearly equal size is apparently confirmed by the dimensions of the vomerine tusks.

Those of the Newsham specimen seem to be quite as large as those of the Scotch specimen; in both they are about equal in diameter at the base. It is true that Prof. Huxley estimates their length in the Scotch specimen to be 3 inches, while, judging from the fragments, we have calculated that the left tusk in our specimen could not be less than 2 inches long; but how much longer it may have been we cannot determine. It is certain that the two fragments into which it is broken, when taken together, measure upwards of 2 inches in length; and it is impossible to say how much the basal portion overlies the upper; moreover, the latter is bent, and the apical extremity is wanting. We think, then, that the disparity in the number and size of the teeth and tusks is not

sufficient to cause us to doubt the specific identity of the two specimens in question.

We must now turn to the character of the teeth themselves. In our specimen they have the same irregularly rounded base as those of the Scotch specimen; and like them they are, towards the apex, a little flattened, giving to the section of the crown an elliptical contour, the long axis being in the direction of the jaw; and on the frontal and dorsal aspects they are slightly carinated. So far the teeth agree; but Prof. Huxley describes the surface of those in his specimen as ridged, not grooved, while in ours they may be said to be both grooved and, to some extent, ridged. The base of the teeth, when in a good state of preservation, exhibits narrow, shallow grooves, the interspaces being comparatively wide and usually a little prominent, though sometimes almost flat. This difference in the two instances is, perhaps, of not much importance, and may be accounted for by the peculiar state of preservation of the specimens: we shall shortly endeavour to show that this is the fact; in the meantime we will say a few words on the internal structure of the teeth. In this respect there is also some slight difference; our sections of the teeth and those described by Prof. Huxley do not exactly agree. The only difference of any consequence, however, can be explained, we think, by supposing that the sections were made from different parts of the tooth. In *Pteroplax*, the pulp-cavity, near the root of the tooth, is radiated, as it is in *Anthracosaurus*; a little nearer the base the radial spaces are wider, a little further up they are contracted, and still higher up they are contracted more, and ultimately they are lost, and the cylindrical form of the pulp-cavity established. We may therefore presume that the sections described by Prof. Huxley were made near to the base of the tooth in *Anthracosaurus*, and consequently the radial form of the pulp-cavity was strongly developed. Our sections are from higher up the tooth; and the result is, that the radiation of this cavity is very imperfect and in part obliterated. In other respects the structure appears to agree with Prof. Huxley's description: but this observation applies only to the general arrangement of the parts; for, as the learned Professor remarks, "the details could only be made intelligible by elaborate figures," and such were not given.

In Mr. Atthey's collection there is a portion of a right mandible which was obtained at Newsham, and which we originally thought belonged to *Pteroplax*, but which we now have no doubt belongs to *Anthracosaurus*. The surface-sculpture of the bone, the general form, character, and internal

structure of the teeth demonstrate this since we have become acquainted with these features in that genus.

The fragment, which is upwards of $2\frac{1}{4}$ inches long, $1\frac{1}{2}$ inch wide behind, and $\frac{3}{4}$ inch wide in front, is the anterior portion of the right mandible; it has attached to it five teeth; in front it is perfect; the posterior portion is broken away close to the fifth tooth, which, though much injured, appears to be about half an inch long. The three next in advance are not quite so long, and are separated from the fifth and from each other by considerable spaces, and from the tooth in front by a space $\frac{3}{8}$ inch in length. This frontal tooth, which is perfect, is half an inch long and $\frac{3}{10}$ inch wide at the base; it is placed a little way from the extremity, where there is a depression, but whether for the reception of the base of a tooth cannot be determined. The surface of the teeth is ridged, particularly towards the base, agreeing in this respect with those in the Scotch specimen; they are a little compressed above; and one, which is tolerably perfect, has the apex slightly carinated.

On making a section of one of the teeth, it is quite obvious that the ridges on the surface are owing to erosion, if not entirely, at least mainly, and that the internal structure agrees very well with that of *Anthracosaurus* when allowance is made for the variation caused by the sections not being made at the same part. Our section was made a little way up the tooth, while those of the Scotch specimen were, as we have already explained, evidently made close to the base.

There can therefore be little doubt that this fragmentary mandible really belongs to *Anthracosaurus*. We have, then, the satisfaction of recording the occurrence in the Northumberland coal-field not only of a considerable portion of the cranium, but likewise of a large fragment of the jaw of this rare fossil.

The large sternal plate, nearly 5 inches long, described in our paper on *Pteroplax**, is probably that of *Anthracosaurus*; it was found in the same locality, and this is the only large Labyrinthodont occurring in the Newsham shale to which it can at present be assigned. We also possess some ribs and vertebræ which perhaps belong to the same animal.

XXI.—*On* Grayella cyathophora, *a new Genus and Species of Sponges.* By H. J. CARTER, F.R.S. &c.

[Plate VII.]

ABOUT a fortnight since, Dr. J. E. Gray kindly sent me a specimen of a marine sponge, with the request that I would

* See Annals of Nat. Hist. ser. 4. vol. i. p. 277.

examine it, which I did; and having found it interesting in many points of view, I obtained his permission to illustrate and describe it. The sponge was originally got in the Gulf of Suez by Mr. M'Andrew, who preserved it in spirit; and the portion sent to me is that represented in the accompanying plate, magnified twice its natural size.

It is quite new both to Dr. Gray and myself; and out of respect for Dr. Gray's labours in this way, it seems to me that I cannot do better than dedicate the genus to him, and call the species, from the little coral-like cups which it bears on its surface, *Grayella cyathophora*.

GRAYELLA, nov. gen.

Grayella cyathophora, mihi. Pl. VII.

Massive, sessile, spreading. Surface undulating, smooth, interrupted by the presence of numerous subcircular, oval or conical, cup-like projections or pores, with here and there a monticular vent. Internally consisting of a distinct dermal layer covering a massive spongiform structure permeated in all directions by numerous cavities and excretory canals. Dermal layer distinct, smooth externally, bearing the cup-like bodies mentioned, with minute papillary eminences between them; consisting of condensed sarcode charged with fusiform, slightly curved, spinous spicules, and connected internally with the parenchyma by prolongations inwards of the cup-like bodies; a looser union generally in other places, between the dermal and the parenchymatous structures. Cup-like body variable in size, below the twelfth part of an inch in diameter, subcircular or oval, flat, shallow, although considerably raised above the general surface of the dermal layer by a smooth vertical wall which is continuous with the latter circumferentially, closed above by a cribriform disk, and open below in the centre, with a funnel-shaped prolongation which is extended into the parenchyma; composed of condensed sarcode like the dermal layer. Cribriform disk more or less concave, formed of a network of sarcode more or less hirsute from the projecting ends of straight, smooth, cylindrical spicules; continuous at the circumference with the wall of the cup; supported for some distance inwards on vertical columns of sarcode, which extend between it and the sides of the cup, but free in the centre, where it is spread over a compressed circular cavity that, as before stated, is prolonged, funnel-shaped, into the parenchyma; cavity in the centre of the cup formed by the cribriform disk above, by the columns of sarcode laterally, and in continuity with the funnel-shaped

prolongation below, whose surface, again, is characterized by the presence of circular rugæ of sarcode more or less reticulated, finally opening by its contracted or narrow end into the commencement of an excretory canal (Pl. VII. fig. 5); under contraction, the cup-like body is conical, puckered at the apex, and vertically ribbed to the base (fig. 9 *c*). Vents monticular, characterized by a puckered state of the dermal sarcode at their openings and more or less absence of the cup-like bodies in their immediate vicinity; consisting of a prolongation of the dermal sarcode, whose free margin more or less covers a subjacent cloacal chamber, furnished with a central elevation, from which radiate three or more septa, or as many as there may be oscular openings into this chamber (figs. 7 & 8). Parenchyma consisting of sponge-substance charged with the curved spicule mentioned, and supported on a reticulated skeleton formed of bundles of the straight cylindrical spicules, overlapping each other and bound together by non-granular transparent sarcode; superiorly attached to the dermal layer, and inferiorly to the object on which the sponge grows; permeated by small cavities and excretory canals characterized by their persistent openness and by having their walls formed of sarcodal rugæ more or less circular, prominent, and reticulated; with apertures of various dimensions in the interstices, for the most part continuous, at their commencement, with the constricted funnel-shaped prolongations of the cup-like bodies, presenting cavernous dilatations here and there in their course, and finally, after uniting to form large trunks, opening by the oscula into the chambers of the vents already described. Spicules of two kinds, long and short; the former just three times the length of the latter. Long spicule smooth, straight, slightly fusiform, almost cylindrical, abruptly terminated, with one end a little sharper than the other; confined to the skeleton-structure of the parenchyma and the sarcodal columns of the cup-like bodies. Short spicule abundant, thickly spinous, slightly curved, fusiform, sharp-pointed, confined to the parenchyma and dermal layer; spines minute, erect, pyramidal. Size of specimen figured 1½ inch long by ½ inch thick; original mass much larger. Colour not stated.

Hab. Red Sea, Gulf of Suez. Sessile, spreading on rocks or hard surfaces.

Obs. This is a very remarkable sponge, for many reasons. In the first place, the cup-like bodies so much resemble those of similar corals, especially when the former are rendered conical and ribbed by contraction, that, in a fossilized state, the cribriform disk alone could determine the point; and to a superficial observer the specimen, even when recent, might

thus easily be mistaken for a coral. It did not, however, escape the keen discrimination of Mr. M'Andrew; and hence we are provided with a species which at once brings the sponges a step nearer to the corals *in form*, and one which may now and hereafter throw much light on the true nature of many fossilized species that otherwise might be doubted.

The cup-like body, averaging in its broadest diameter 1-12th of an inch, far surpasses in size anything of the kind hitherto met with in the sponges. Witness a similar apparatus which I have lately described and figured in *Pachymatisma Johnstonia* (Annals, this volume, pl. 2. fig. 12 &c.), where it is depressed and not more than a quarter the diameter of the cup-like body in *Grayella cyathophora*.

This, too, I think, is the first instance on record where the pore (for such is the nature of the cup-like body) has been shown to be in direct communication with the excretory canals.

Although the surface of the dermal layer between the cup-like bodies is minutely papillated, and each papilla might, in the recent state, have presented an aperture, which the sponge itself, or the astringency of the spirit in which it was preserved, may have closed, I only saw one here and there; and these were as often in the depressions between as upon the papillæ themselves. Hence I am inclined to infer that such apertures are adventitious. In some instances they appear to be the buds of new cups; but for the most part the dermal layer is perfectly smooth, and hirsute only over the cribriform disks.

The cups, again, have the power of closing themselves; but whether this is produced by the general contraction of the reticulated sarcode of the cribriform disk, or by that of the walls of the cup alone, or by both synchronously, I am ignorant. When, however, it does take place, the cups, in successive degrees of contraction, show that the apertures of the cribriform disk are more or less closed by the approximation of the reticulated structure; and the margin generally yielding as well, causes the cup to assume a conical form, puckered at the apex and ribbed vertically down its sides, in the manner of a coral-polype (fig. 9 *a*, *b*, *c*).

After the water has passed through the concave cribriform disk (convex or flat when living?), it reaches the internal cavity or chamber of the cup, and thence flows on to the constricted end of the funnel-shaped prolongation, which, being provided with the circular ribs or rugæ of sarcode mentioned, may also have the power of total closure, especially at the point where it opens into the commencement of the excretory canal to which it is attached (fig. 5 *c*, *f*).

The excretory canal, too, is observed to be much wider than

the constricted end of the funnel which here joins it, and to be formed, apparently, of much less rigid structure. The sarcodal rugæ are much more openly reticulate, although still tending to a circular arrangement; and apertures of different dimensions begin to appear in the interstices of the reticulation (fig. 5 *g*, *h*, *i*).

One cannot help being struck with the resemblance in form of these rugæ (which are indistinctly fibrous under compression and a high power) to the *carneæ columnæ* of the heart in warm-blooded animals; nor can one help associating the patent character of the canals with this structure surrounding them, and the apertures in the interstices, with the tracheæ of insects. We see also how the extent of surface thus becomes multiplied, how these projecting rugæ assimilate the structure to that of the frog's lung, where, for aëration, the internal surface of the hitherto simple sac in fishes begins to shadow forth the vesicular character and vast extent of surface exposed for aëration in the fully-developed lungs of the mammalia; nor can we, finally, fail to conclude that the excretory system of canals in this and probably all other sponges may, at least partly, subserve this purpose.

I have not been able to pass a bristle from the vent on the surface through the excretory canal in the parenchyma to the cribriform disk of the cup-like body, or *vice versâ*. Neither could it be expected, with so many loose valvular projections intervening, and such tortuous passages, that the top of a bristle would be thus unimpeded in its transit. But a bristle can be easily passed through the truncated ends of the large excretory canals in the parenchyma to the vent on the surface; and when these canals are compared with the canals into which the funnel-shaped prolongation of the cup-like body empties itself, their structure is found to be identical. If this identity alone be not considered sufficient to establish the fact that the cup-like body opens directly into an excretory canal, then the fact that there are no other canals of the kind in the sponge for it to open into but the excretory system is decisive. The bristle for this purpose should be burnt at one end, to give it a round form, or "probe-point."

We next come to the apertures opening into the excretory canal itself through the interstices of the sarcodal reticulations; and this brings us to the subject of nutrition, with which the excretory system, in combination with the cup-like bodies, must be as much connected as with aëration (fig. 5 *i*).

No doubt many of these apertures are the openings of branches of the excretory canal-system which may belong to as many cup-like bodies; but then there are others which

seem too minute for this. In short, there are many more apertures than there are cup-like bodies; so we have to account for the superfluity.

It is evident that Prof. Huxley's hypothetical diagram (Introduct. to the Classification of Animals, p. 15, fig. 4), by which a globular cavity lined with ciliated sponge-cells is made to have two apertures (viz. one receiving a stream of water directly from the exterior, and the other transmitting it into the excretory canal), will not apply to *Grayella cyathophora*. We must have another hypothesis here, more especially for the canals which do *not* communicate with a cup-like body.

Certainly, in the young *Spongilla*, growing from the seed-like body, the particles of food (carmine) may be seen to pass into the general chamber surrounding the parenchyma, and thence into ampullaceous sacs imbedded in the latter. That these sacs are lined with monociliated and unciliated sponge-cells which incept the particles, apparently transmitted through a single aperture in this sac, is also evident. But I could never see how the undigested portions got into the excretory canals. I had therefore to conceive that it took place through the bodies of the sponge-cells themselves, as a particle might be incepted on one side of an *Amœba* and ejected at the other—in short, that the sponge-cells of the ampullaceous sac acted as a kind of partition between the chamber receiving the particles and the canals carrying off the refuse. (See my figures and descriptions of the ultimate structure of *Spongilla*, Annals, ser. 2. vol. xx. p. 21.)

But, be this as it may with *Spongilla*, it is with *Grayella cyathophora* that we are now chiefly concerned; and here, although it is plain that there is a direct communication between the cup-like body and the excretory canal, it is equally plain also that this is chiefly for aëration and for the admission of nutritive particles to some other organs.

We have therefore to look for these organs; and falling back upon the canals which do not come directly from the cup-like bodies, and certain cavernous excavations in the parenchyma above mentioned, which appear to be dilatations of the excretory canals along their course, analogous to, if not homologous with, the areolar cavities in *Pachymatisma Johnstonia* (Annals, this volume, pp. 12 & 13), it does not seem improbable that the sponge-cells which incept the particles may be here situated.

But whether they are in vesicular dilatations (like the "ampullaceous sac") at the ends of these canals, or whether in globular dilatations like those in Prof. Huxley's hypothetical

diagram, situated on canal-loops which have thus two openings in connexion with an excretory duct, future discovery must determine.

It is useless to attempt this in a sponge which has been preserved in spirit, or in any other way after death; for the sarcode is too delicate to retain the form of its minuter parts unaided by vitality. Hence it is necessary to pursue these researches with the sponge in the living condition, and under experiments perhaps similar to those instituted by myself in the examination of *Spongilla*, whose ultimate structure, so far as I have gone, never could have been obtained under any other circumstances. In the present instance, however, we may consider ourselves fortunate in having met with a species in which the continuity of the pore or cup-like body and the excretory canal can be clearly demonstrated even after preservation.

Another question, which can only be determined during life, is the form and nature of the sponge-cell engaged in the nutritive function.

In Prof. James-Clark's valuable paper (Memoirs of the Boston Society of Nat. History, read June 20, 1866, and reprinted in the 'Annals,' 1868, ser. 4. vol. i.), it is naturally urged that, because the ciliated cells of the calcareous sponge called *Leucosolenia botryoides* have a funnel-shaped process round their cilium, and particles drawn by the cilium into the funnel pass thence into the body, they are taken into the latter through a fixed oral aperture, close to which also the undigested portions make their exit, as in his genus *Codosiga* &c., among the flagellated Infusoria. Further, Prof. James-Clark thinks it not improbable that such might be the case with the ciliated cells of *Spongilla* possessing the ear-like appendages which I have figured in the 'Annals' (ser. 3. vol. iii. pl. 1. figs. 12, 13, 14), these being, in his opinion, merely the sides in profile of the funnel-shaped process not otherwise seen—an appearance which he himself has recognized. But it may be observed that, among the sponge-cells of the "ampullaceous sac" of *Spongilla* (*l. c.*), there were not only monociliated but also unciliated sponge-cells which had equally incepted the particles of carmine. It is possible that the funnel-shaped process and the cilium may have been retracted here, in accordance with Prof. James-Clark's observations of the latter in *Codosiga* (p. 193, *l. c.*) and of the former in *Leucosolenia* (footnote, p. 208, *ib.*); and this might be his explanation of their absence, the oral orifice remaining fixed and stationary as before. Still such retraction would not be less characteristic of the Rhizopoda than of the Infusoria flagellata.

But Prof. James-Clark, in alluding to my statement that the sponge-cells are allied to the Rhizopoda, from the probability of their having no fixed oral aperture but the power of polymorphism and the inception of particles of food at any point of the body &c., announces his "firm conviction that the true ciliated *Spongiæ* are not Rhizopoda in any sense whatever, nor even closely related to them, but are genuine compound *flagellate Protozoa*" (*l. c.* p. 206). To what extent the "true ciliated *Spongiæ*" may be carried does not appear, although it seems evident that the expression includes the calcareous sponges.

Now, a short time since, having had to break up, for microscopical examination, a living portion of a calcareous sponge, viz. *Grantia ciliata*, which is closely allied to *Leucosolenia*, I observed that, after a little while, the cilia ceased to appear (were retracted?), and that the cells all began to creep about the glass by expansions identical with those of *Amœba*. Hence I still, even among the calcareous sponges, must adhere to my opinion that they as well as *Spongilla* are closely allied to the Rhizopoda.

Prof. James-Clark assumes, on the inferences above stated (for he did not actually see the oral aperture either in the cells of *Leucosolenia* or *Codosiga*), that there is a fixed mouth and an anal orifice close by it, and therefore that the animal expression (if I may use the term) of the "true ciliated Spongiæ" is a flagellated Infusorium not allied to the Rhizopoda "in any sense whatever."

I also, on inferences above stated, assume that the sponge-cell is almost identical with *Amœba*, and therefore that all the sponges are intimately allied to the Rhizopoda.

It is but fair, however, to add that I have not yet had time to search for the signs of the flagellate Infusoria delineated and described by Prof. James-Clark, viz. the funnel-shaped process surrounding the cilium &c., and therefore am not able to confirm or disprove his conclusions in this respect. At the same time, I think, the fact of the amœboid organisms beginning life as flagellated Infusoria, and afterwards exchanging (retracting?) the cilium for a polymorphic condition, if they do not occasionally present both forms in combination, points to a nearer alliance between the two than Prof. James-Clark's "conviction" above quoted would allow.

Lastly, the formation of the vents in *Grayella cyathophora* is peculiar; for the oscula do not open directly upon the dermal layer as in most other sponges, but into a cloacal chamber which is formed over them by a prolongation of the dermal sarcode, evidencing by its puckered orifice that it also

has the power of opening and closing itself as occasion may require (figs. 7, 8).

EXPLANATION OF PLATE VII.

Fig. 1. *Grayella cyathophora*, n. sp., magnified twice the natural size; showing cup-like bodies or pores and vents.

Fig. 2. The same, small spinous curved spicule of the dermal layer and parenchyma, magnified. Size 7-1800ths long by about 1-8000th inch broad.

Fig. 3. The same, portion of spinous spicule more magnified, to show form of spines.

Fig. 4. The same, large, smooth, straight spicule of skeleton and cup-like body, magnified. Size 20-1800ths long by about 1-6000th inch broad.

Fig. 5. The same, vertical section of one of the cup-like bodies, greatly magnified (scale 1-48th to 1-1800th of an inch): *a a*, cup; *b b*, its continuity with the dermal layer; *c c*, cribriform disk supported on sarcodal columns, in which are imbedded the smooth spicules whose ends project beyond the surface; *d*, portion of cribriform disk covering the cavity or central chamber of the cup; *e*, vertical section of funnel-shaped prolongation of central chamber, showing its circular rugæ; *f*, its constricted end opening into *g*, the commencement of an excretory canal; *h*, reticulated sarcodal rugæ, characteristic of the internal surface of the excretory canals; *i*, apertures opening into excretory canal between the reticulations of the sarcodal network.

Fig. 6. The same, cribriform disk magnified on the same scale. Foramina varying from 1-1800 to 1-300th of an inch in diameter.

Fig. 7. The same, vertical section of vent, greatly magnified and diagrammatic, to show:—*a*, opening of cloacal chamber; *b*, prolongation of dermal layer forming the sides of the chamber; *c*, papillary eminence in the centre of the chamber, from which radiate as many septa to the sides of, as there are oscula opening into, the chamber; *d*, *d*, portions of chamber leading down to oscula.

Fig. 8. The same, horizontal section of vent, greatly magnified and diagrammatic, to show:—*a*, external surface of dermal prolongation forming cloacal chamber; *b*, cut edge of same; *c*,*c*,*c*,*c*, openings of oscula; *d*, horizontal section of papillary eminence and septal divisions.

Fig. 9. The same, portion of dermal layer, to show three cup-like bodies in different degrees of expansion and contraction respectively, magnified 6 diameters; also the minute papillary elevations between them: *a*, fully expanded cup; *b*, half-expanded cup; *c*, wholly contracted cup, showing its ribbed coral-like form from contraction; *d*, minute papillary elevations on dermal surface.

Fig. 10. The same, portion of dermal layer, magnified, to show the disposition of the small spinous spicules with which it is charged.

XXII.—*Notulæ Lichenologicæ.* No. XXX. By the Rev. W. A. Leighton, B.A., F.L.S.

Further Notes on the Lichens of Cader Idris, North Wales.

Ever since my last visit to Cader Idris, in 1866 (see Not. Lich. No. XV., 'Annals,' ser. 3. vol. xix. p. 402), it has been my wish to return to that mountain and explore the cwms on the south side for lichens. On July 12, 1869, I set off thitherward with my friend the Rev. H. E. Lowe, of Atherstone, who is an enthusiastic admirer of ferns. We started from Shrewsbury by an excursion train, which afforded us a four days' trip, at 8.30 A.M., to Ruabon, thence through the vale of Llangollen to Corwen and the beautiful Lake of Bala, onward to Dolgelly, which place we reached about noon. We immediately took a car to Minfford, eight miles distant, passing the celebrated Torrent Walk into the Talyllyn pass, terminated by its glittering lake. Minfford, or "the little inn by the roadside," as the name signifies, was very convenient for our purpose, being situated close under Llyn Cae, the great feature of this southern side of Cader Idris. Here we found everything clean and comfortable, and the people attentive and obliging. Being a splendid sunshiny evening, we determined at once to ascend into the cwm, and accordingly took our path on the left side of the torrent brook which flows from Llyn Cae. For the first few hundred yards upwards, the ascent was steep and trying, but afterwards became most unexpectedly easy; and very shortly turning on the left, we at once entered the cwm, which was a magnificent and extensive grassy valley lying east and west. Proceeding westward by the brook-side, over the gradually inclined grassy slopes and moraines, we eventually reached the lake. The grandeur and sublimity of this wild solitude are beyond all adequate description. The large lake, with its deep black waters surrounded on all sides by towering precipices rising from its very margins, the strata of the rocks upheaved into perpendicular positions, the enormous hollow cwm scooped out by former glacial action, the rapid alternations of light and shade ever hurrying over the escarpments, the light floating mists like a filmy veil rolling over the summits, and the solemn stillness unbroken only by the plash of the lake or the occasional cries of the buzzard and raven—altogether impress the mind in a manner not easily to be erased. We passed entirely round the lake, and descended about 8 P.M. to Minfford.

During the progress I gathered *Lecidea rivulosa*, Ach., *Lecidea contigua*, Ach., in various states, *L. phæops*, Nyl., *L.*

lithophila, Ach., *L. fuliginosa*, Tayl., *L. concreta*, Whlnb., *Cladonia cervicornis*, Ach., of immense size and in magnificent fructification, *Stereocaulon denudatum*, Flk., *Placopsis gelida*, (L.), *Lecanora atra* (L.), *L. leucophæa*, Flk., *Lecanora biformigera*, Leight., in beautiful condition, *Spilonema paradoxum*, Born (sterile), and a curious composite *Sphæria* growing parasitically on the thallus of *Parmelia saxatilis*, L., having spores 8, fuscous, fabæform or subelliptical, 3-septate.

The following day (Tuesday) we ascended the pass to the "Giant's Pebbles," on which I collected *Lecidea rusticula*, Nyl., *L. fuliginosa*, Tayl., *Lecanora leucophæa*, Flk., and *Pilophoron fibula*, Tuck., new to Great Britain, and only before known as occurring in the White Mountains, North America. Thence over Geu Craig, where I gathered *Lecidea contigua*, Ach., f. *hydrophila*. Descending on the north side to Llyn Aran, we found *Stereocaulon cereolinum*, a minor state of *S. condensatum*, Hffm., *Verrucaria irrigua*, Tayl., *Lecidea phæops*, Nyl., and *L. jurana*, Schær. Time pressing, we could not delay, but scrambled again to the summit, and descended by a very formidable descent over projecting rocks and loose "screes," interspersed with safe grassy patches down the precipices north of the lake into Llyn Cae, and so by the torrent-side to Minfford. This was rather a day of scrambling than of collecting; but we determined to devote Wednesday entirely to Llyn Cae, where my gatherings were *Lecidea contigua*, Ach., f. *oxydata* (K – C –), *L. fuliginosa*, Tayl., *L. jurana*, Schær. (K – C –), *L. amphibia*, Fr. (K + C +), *L. phæa*, Ach.? (K – C –), *L. rivulosa*, Ach. (K +), *L. lapicida*, Fr., var. *declinans*, Nyl. (K +), *L. petræa*, Flot., *L. geographica*, L., *L. phæops*, Nyl. (K + C +), *L. panæola*, Ach. (K yellow, C red), *L. consentiens*, Nyl. (K – C –) (new to Wales), *Lecanora cinerea* (L.) (K +), and its form *Acharii*, E. Bot. 1087, *L. leucophæa*, Flk., *L. biformigera*, Leight. (K + C +), *Placopsis gelida* (L.) (K yellow, C red), *Opegrapha tesserata* (DC.) (K +), *Urceolaria scruposa*, Ach., *Lecanora atra*, Ach. (K +), *Endococcus perpusillus*, Nyl., *Verrucaria irrigua*, Tayl., *Pilophoron fibula*, Tuck., in magnificent profusion, and a new species of *Lecidea*, which I name *plicatilis*, and describe below.

Thursday being the tether of our trip, we returned homewards.

Lecidea panæola, Ach., is well represented in Fellm. Lich. Lapp. Or. 182! Schær. L. Helv. 469! and Anzi, Lich. Langob. 83! Its chemical reaction is K yellowish, C red. It is figured under the name of *athroocarpa* in E. Bot. 1829. Mr. Borrer's Herbarium at Kew contains it from Cader Idris, by Dickson named "*L. niveo-ater*, Dicks.," also from "rocks above

Corwen, Rev. T. Salwey," and as "*Lecidea compressa*, MSS., Carig Mountain, co. Kerry, Dr. Taylor." I have myself gathered it at Llyn Aran, Cader Idris; Cwm Glas, Snowdon; and Abdon Burf, Shropshire; and possess it from "Smolandia, Femsjo, Dr. Th. M. Fries." Dr. Nylander, *in litt.*, says of it:—"*L. panæola*, Ach., est caractérisé par ses céphalodies ('granulis tuberculosis lilacino-rufescentibus'). C'est la seule espèce parmi les Lecidées (et *Lecanora*) qui possède des céphalodies, et elles sont constantes."

Of *L. phæops*, Nyl., Mr. Carroll, in Seem. Journ. Bot. 5. 255, says, "= *Lecanora rhætica*, Hepp, var. *hyperborea*, Nyl. (*olim*)." Dr. Nylander's description of *phæops*, in his Lich. Scand. 196, is excellent and characteristic. Its chemical reaction is K yellow, C yellow. The Herb. Borrer. has it from Dr. Taylor, "on wet rocks near Dunkerron," and "on Cappamore Hill, co. Kerry," but labelled "*Lecanora cyrtaspis*, Ach. L. U. p. 397?," as Mr. Borrer justly remarks, "incorrectly."

True *Lecanora rhætica*, Hepp, will be found in Arn. Exs. 117 and Anzi, Lich. Langob. 151, it has no chemical reaction (K – C –), and is well described in Anzi's Catal. p. 82, as *L. nivalis*, Anzi.

Lecidea consentiens, Nyl., has no chemical reaction (K – C –), and has the appearance of some states of *Lecanora cinerea* (L.), with the white smoothish rimuloso-diffract thallus of *phæops*, Nyl., from which, however, it differs by the plane, innato-impressed, obtusely margined, black apothecia, with thin blackish hypothecium, and spores ellipsoid, as large as those of *L. panæola*, Ach. It must be remarked that my Llyn-Cae specimens of *consentiens* have most certainly pale cephalodia; and if *panæola* really be the only species which possesses cephalodia, as Dr. Nylander asserts, then our *consentiens* would seem referable as a state of that species, were it not for the different chemical reaction (K yellow, C red), as well as other characters.

In his Syn. Lich., Dr. Nylander considers *Stereocaulon cereolinum*, Ach., a minor form only of *S. condensatum*, Hffm.; and as he has had full opportunities of examining the Acharian Herbarium, no doubt he is correct. He cites, as a figure of this, E. Bot. Suppl. 2667. The Rev. Thomas Salwey, who first detected *Stereocaulon cereolus*, E. B. S. 2667, on Cader Idris, in his list of Welsh Lichens gives as particular localities for it, "about Llyn Gwernon," and "at foot of Cader Idris;" and the lichen which I have found in those places is a variety of *S. condensatum*. The herb. Borrer. at Kew contains similar specimens "from Llyn Gwernon," and from

Stenhammer, Lich. Suec. 85; Th. M. Fries, Lich.; and from "Dunkerron, Ireland, Dr. Taylor." It is also given in Anzi, Lich. Ital. Sup. 30, M. & N. 947, and Korb. L. Sel. Germ. 271. The Rev. John Harriman's specimen from Teesdale, in herb. Borrer., mentioned in E. Bot. Suppl., most nearly resembles the figures in that work, but was in too old and imperfect a condition to allow of the sight of the spores, which are cylindraceo-fusiform, 3–7-septate.

I suspect that, in my Lich. Brit. Exs. 383, I have distributed both plants, *S. cereolinum* and *Pilophoron fibula*, as I have gathered both about Llyn Aran; but microscopical examination will rectify this, the spores of *Pilophoron fibula* being elliptical and simple. The granules of the thallus are also much more flattened and squamaceous. So far as my experience goes, *S. cereolinum* affects the horizontal surfaces of boulders, whilst *Pilophoron fibula* grows on the perpendicular faces of wet rocks. I believe also that I gathered *Pilophoron fibula* in Cwm Glas, Snowdon, in 1865, a single specimen only, which, unfortunately, I have lost.

It may be useful perhaps to remark that in *Lecidea contigua*, Ach., and *L. confluens*, Ach., the apothecia arise from the thallus, in *L. petræa*, Flot., and *L. fusco-atra*, Ach., from the hypothallus. *L. contigua* has the disk of the apothecia *pruinose*, either white or, when old, of a rusty brown, and is always, when seen under a lens, *roughened* by the prominent apices of the paraphyses. The margin is very thick and obtuse, the lamina proligera reclines on an enormously thick black or blackish-brown *cupular* excipulum, and the spores are oval or oblong, and *very large*. *L. confluens* is at once known by the *very black*, *smooth*, *velvety* appearance of the disk, which is *altogether destitute of white pruina*. The excipulum is somewhat similar to that of *contigua*; but the spores are scarcely half the size. *L. petræa* has the thallus in *verrucose* areolæ, and the spores oblong and of a muriform character, with horizontal and perpendicular septa. *L. fusco-atra*, again, is well marked by the areolæ of the thallus being shining on their *plane or flattened surface, and the edges of each areola raised up into a very thin sharp margin.* The spores are similar in shape and size to those of *L. confluens.*

Lecidea plicatilis, Leight., n. sp.

Thallus sordide albidus, minute plicato-verrucoso-granulosus, areolato-diffractus, hypothallo fusco; apothecia majuscula, undulato-plana, nigro-fusca, arcte adnata, connato-deformia, margine obtuso undulato ætate plus minusve attenuato aut obliterato; sporæ 4–8, incolores, elongato-ellipsoideæ, 3–4–5-septatæ, constrictæ, murali-divisæ; hypothecium

crassum, nigro-fuscum; gelatina hymenea iodo intense cærulescens.

Ad rupes, Llyn Cae, Cader Idris.

This lichen has much the general aspect of old specimens of *Lecidea Bruyeriana*, Schær., which have the thallus well developed; but it is abundantly distinct by the characters above noted. The thallus becomes yellow with hydrate of potash, which colour also remains on the subsequent application of hypochlorite of lime.

XXIII.—*Descriptions of three new Species of* Callidryas. By Arthur G. Butler, F.L.S.

I have for some time contemplated writing a monograph of the species of *Callidryas*, not only because there are in that genus many species of great beauty still undescribed, but because the sexes of the different species are not rightly made out, and need careful investigation. It was my intention to commence my revision of the genus in the second part of my 'Lepidoptera Exotica;' but an unexpected influx of new species of *Charaxes* has rendered this an impossibility. The following new species will be figured in their proper places in that work.

1. *Callidryas flava*, sp. nov.

♂. Alæ supra flavæ, area apicali anticarum dilutiore, margine costali nigro punctisque nervulos terminantibus apicalibus nigris: corpus nigrum flavo hirtum, abdomine flavo.

Alæ subtus flavæ, area anali anticarum albicante: corpus flavo-albidum.

Exp. alar. unc. 3.

♀. Persimilis *C. Endeeri*, magis autem flavescens maculisque anticarum submarginalibus in medio interruptis.

Exp. alar. unc. 3, lin. 2½.

Hab. Celebes. B.M.

♂ ♀. Obtained 1858; collected by A. R. Wallace, Esq.

Allied to *C. Jugurtha*, Cramer (var. *C. Endeer*, Boisd.), but differs in the male being of a uniform yellow colour, as in some extreme varieties of that species, and with a much narrower black apical border to the front wings; the female is also of a brighter yellow than in *C. Endeer*, and has the submarginal spots of the front wing interrupted by brown.

2. *Callidryas rorata*, sp. nov.

♂. Alæ supra velut in *C. Argante*, punctis autem marginalibus majoribus: subtus flavæ, fusco roratæ, striis squamosis velut in *C. Argante* latioribus, maculis argenteis velut in *C. Larræ* mari.

Exp. alar. unc. 3, lin. 3.

♀. Similis feminis nonnullis *C. Argantes*, major et alis pallide ochraceis, fasciis macularibus distinctis majoribus, fundoque (præcipue posticarum) rufo rorato.

Alæ subtus flavæ, brunneo omnino striolatæ, apice anticarum fulvescente; maculis permagnis brunneis puncta argentea includentibus mediis, velut in *C. Larræ* femina sed majoribus; fascia maculari discali plumbageo nitente.

Exp. alar. unc. 3, lin. 1.

Hab. St. Domingo. B.M.

♂ ♀. Obtained 1855; collected by Mr. Tweedie.

This is the Haitian representative of *C. Larra*, a species allied to *C. Argante*, but referred, in the 'Genera of Diurnal Lepidoptera,' to *C. Philea*, of which it is supposed to be the female. I have seen specimens of *C. rorata* in Mr. Salvin's collection, also from St. Domingo.

3. *Callidryas solstitia*, sp. nov.

♂. Alæ anticæ supra flavæ, plaga magna media rufa, certo situ roseo micante et a venis flavis interrupta; puncto pone cellam nigro, margine ochraceo: posticæ fulvæ, area externo-anali ferruginosa, venis costaque basali flavidis, margine externo ochraceo: corpus flavo hirtum, abdomine flavo, palpis colloque fulvo.

Alæ subtus fulvæ, characteribus consuetis fuscis squamosis punctisque mediis argenteis.

Exp. alar. unc. 3, lin. 7½.

♀. Alæ supra roseæ, area apicali anticarum fulvescente, posticarum rufescente: characteribus omnibus velut in *C. Thalestre*, fuscis.

Alæ subtus velut in *C. Thalestre* coloratæ.

Exp. alar. unc. 3, lin. 7.

Hab. Chili. Coll. Druce.

♂ ♀. From the Kaden Collection.

This magnificent species is allied to *C. Thalestris*, the females of the two species being very similar; the males, however, are widely distinct.

XXIV.—*Descriptions of some new Species of* Lamiidæ. By Francis P. Pascoe, F.L.S. &c.

List of Species.

Achthophora fasciata. *Labuan.*
Agelasta mystica. *Manilla.*
Coptops centurio. *India.*
Crossotus stypticus. *Damaraland.*
Daxata confusa. *Penang.*
Mispila curvilinea. *India.*
Mœchotypa adusta. *Laos.*
Rhytiphora Dallasii. *W. Australia.*
Symphyletes defloratus. *Champion Bay.*
—— lanosus. *Champion Bay.*
Thysia viduata. *Sumatra.*
Nyctopais Thomsoni. *Gaboon.*
Anthores leuconotus. *Natal.*

Achthophora fasciata.

A. fusca, pube fulva sparse vestita; elytris fascia determinata postica alba; antennis haud ciliatis, art. quarto incrassato.

Hab. Labuan.

Dark brown, with a sparse fulvous pubescence between the punctures on the elytra, but with small naked spots, each having a fine puncture in the centre, on the prothorax; head with an uninterrupted pubescence; lip and palpi testaceous; prothorax short, transverse, not tuberculate at the sides, punctures irregularly dispersed; scutellum semicircular, concave; elytra entire at the shoulders, punctures rather large, irregular, crowded at the base, here and there separated by a granular elevation, between the middle and apex a broad distinct white band; body beneath brownish testaceous, with a yellowish pubescence speckled with small naked spots; antennæ not longer than the body, not bearded, the third joint very thick until near the apex, dark brown, the succeeding joints testaceous, clouded outwardly with brownish. Length 5 lines.

This can only be considered a doubtfully aberrant form of *Achthophora*: the absence of the protuberance at the shoulders and the thickness of the third and fourth joints of the antennæ will probably lead to a genus being formed for its reception.

Agelasta mystica.

A. atra, lineis fasciisque niveis bene limitatis decorata.

Hab. Manilla.

Deep black, covered with a very short yellowish-brown pubescence, marked with slender, perfectly limited, snowy-white bands and stripes, and entirely impunctate; head with three stripes, the intermediate one divided in front by a narrowly elevated line, an irregular spot behind the eye; prothorax with nine stripes, but two or three on each side little more than spots, the basal margin edged with a narrow band; scutellum transversely triangular; elytra rather short, one band near the base, but behind the scutellum, and a second behind the middle, between the two on each elytron four or five spots or short bars, near each apex a spotted transverse line, and behind it two longitudinal bars; body beneath black, very sparingly pubescent, edges of all the abdominal segments and of the metasternum edged with white; legs black, femora on their upper edges lined with white, fore tibiæ curved; antennæ with the bases of the third to the sixth joints, inclusive, white at the base. Length 6½ lines.

An isolated species in coloration, but in form coming nearest to *A. amica* and *A. polynesus*; but with a more decidedly transverse prothorax than either.

Coptops centurio.

C. nigra, fulvo-cervino pubescens, maculisque albis interjectis; elytris maculis nigris fasciis duabus formantibus.

Hab. India.

Black, closely covered with a fulvous fawn-coloured pubescence, spotted with white, and on the elytra having two imperfect black bands formed of numerous approximate and contiguous spots; head very sparsely punctured; prothorax very irregular above, the basal tubercle, as well as the two anterior, rather strongly marked; scutellum very broad at the base, incurved at the sides, truncate at the apex; elytra sparingly punctured, each puncture in the centre of a white spot, the first band midway between the base and middle, the second a little behind the middle; body beneath greyish fulvous, the middle of each abdominal segment with a subtriangular black denuded patch; legs and antennæ with fulvous fawn and dark brown pile. Length 10 lines.

A very distinct species, apparently most allied to *C. petechialis.*

Crossotus stypticus.

C. confuse griseo tomentosus; prothorace sparse punctato; elytris basi fusco nebulosis, utrinque pone medium macula transversa fuscescente; tibiis anticis parum arcuatis.

Hab. Damaraland.

Dark brown, covered with a grey, more or less confusedly spotted with darker grey, irregular tomentum; head with a narrow black impressed median line, an oblique line also on the vertex on each side; prothorax short, broader at the base than at the apex, a stout spine on each side behind the middle, with a few distinct punctures above, an undefined brown stripe above the spine; scutellum truncate at the apex; elytra with a few punctures at the base, and three or four small tufts of black hairs on each, including one on the shoulder, obscurely clouded with brown, behind the middle a brownish transverse spot near the outer margin; body beneath, legs, and scape of the antennæ grey speckled with brown, the rest of the joints greyish, gradually darker towards their apices, all those at the base with a rather dense black fringe. Length 9 lines.

This species, besides its colour, has a more transverse prothorax than *C. plumicornis* or *C. natalensis*, which appear to

me to be the only two other published species to be referred to the genus.

Darata confusa.

D. leviter pubescens, fusco-fulva, cinereo nebulosa, et nigro maculata; fronte capitis transversa; elytris singulatim bituberculatis, uno basali, uno postmediano.

Hab. Penang.

Covered with a short thinly set pubescence, chiefly pale brownish fulvous, but clouded with small patches (under the lens) of pure ashy, and spotted with dark brown; head very broad and transverse in front, greyish, spotted with fulvous; prothorax short, irregular, the sides transversely wrinkled, the base blackish, the middle with the fulvous collected into an indistinct band; scutellum triangular; elytra ample, each somewhat tricarinate at the base, the inner carina crowned with a narrow tubercle, behind the middle another and smaller tubercle in line with the first, behind this and towards the outer margin are two oblique brown bars; body beneath and legs with a thin grey pubescence mottled with naked spots, the femora fulvous above; antennæ brown, the joints from the third ashy at the base. Length 9 lines.

This has, *inter alia*, a larger and proportionally broader head than either of the two other species of the genus, and it has moreover an extra pair of tubercles on the elytra.

Mispila curvilinea.

M. fusca, pube griseseente parce vestita; fronte capitis quadrata, rugoso-punctata; prothorace fere regulari; antennis unicoloribus.

Hab. India.

Dark brown, covered with a short, thin, greyish pubescence; head square in front, very roughly punctured; prothorax nearly regular, the sides rounded, above with scattered punctures and two large well-limited patches, divided by a narrow central line, greyish brown; scutellum broad, rounded behind; elytra subseriately punctured; from the shoulder a pale narrow well-marked line descends in a curved direction downwards to near the middle, and posteriorly similar short zigzag marks occur at the sides; body beneath and legs greyish, spotted with brown; antennæ with a uniform greyish pubescence. Length 8½ lines.

A more robust species than *M. venosa*, with the head quadrate in front, the antennæ unicolorous, and without the long hairs covering the body as in that insect.

Mœchotypa adusta.

M. breviuscula, fusco pubescens, medio elytrorum grisea; elytris singulatim cristis duabus basalibus vix elevatis, et haud plumosis.

Hab. Laos.

This species approaches *M. chinensis*, Thoms., but is much shorter, the colours more clearly limited, only two short slightly elevated crests at the base of each elytron, although there is a vestige of another between them, a round brown spot on the middle near the suture, and the underparts of a clear pinkish colour. Length 9 lines.

Rhytiphora Dallasii.

R. fusca, nitida, vittis fasciisque argenteo pubescentibus ornata.

Hab. Western Australia.

Head dark brown, shining, confluently punctured; margin round the eye, a curved line above it, and a stripe in front white; antennæ rather shorter than the body (♂), brown, the four basal joints with a white pubescence, third to fifth bearded beneath; prothorax cylindrical, rather broader than long, finely wrinkled transversely, the margins and three bands white; scutellum subscutiform, brown; elytra elongate, gradually narrower from the shoulders to near the apex, the sutural line, a narrow stripe not reaching to the apex, and another broad stripe extending from the shoulder to the apex denuded and glossy brown, the intervening portions covered with a dense pure silvery white pubescence, the humeral stripe more or less divided by a longitudinal series of white spots; body beneath closely pubescent, glossy white; sides of the metasternum and an oblique spot on each side of the four basal segments of the abdomen denuded, brown; legs with a close white opaque pubescence. Length 15 lines.

One of the most striking and distinct of the Australian Longicorns; its name is intended to serve as a mark of appreciation of the author of the masterly reports on entomology in the 'Zoological Record.'

Symphyletes defloratus.

S. ferrugineus, griseo pubescens; prothorace postice angustiore, dorso tuberculis duobus in medio instructo; elytris basi bicristatis, humeris fortiter granulatis, apicibus bidentatis.

Hab. Champion Bay.

Ferruginous, covered with a short, rather dense (except that the middle of the elytra is somewhat denuded), greyish pubescence, closely but indistinctly speckled with fulvous; head

marked with small dark points; antennæ about as long as the body, the scape scarcely thicker than the third joint; prothorax slightly transverse, narrowest at the base, the middle with two small but very distinct tubercles; scutellum broadly rounded behind; elytra not elongate, gradually narrower from the base, between the scutellum and shoulder, on each side, two longitudinal tuberculate crests, the inner longest, shoulders strongly granulate, an indistinct brownish patch on each side near the middle, apices bidentate; body beneath with a coarse yellowish-grey pubescence, with small denuded spots at the sides; legs also yellowish grey, with spots on the femora and tibiæ. Length 9 lines.

Allied to *S. cinnamomeus*, but without any bands on the elytra; the prothorax of the latter broader, not narrower, at the base, &c.

Symphyletes lanosus.

S. robustus, ferrugineus, denso griseo lanosus, super elytra setulis sparsis interjectis, dorso prothoracis subtuberculato; elytris basi latis, subbicristatis.

Hab. Champion Bay.

Robust, ferruginous, densely covered with a greyish woolly pubescence; head rather narrow in front; antennæ about as long as the body, uniformly grey; prothorax nearly as long as broad, narrowest at the apex, the back with a few indistinct tubercles, but two more prominent than the rest; scutellum somewhat quadrate; elytra much broader at the base, rapidly narrowing posteriorly, with many minute erect bristles scattered amongst the pubescence, at the base, on each side, three short lines of granules, the largest near the suture, forming, as well as the second line, a sort of crest, the outermost line nearly obsolete, apices bispinous, clothed with longish hairs; body beneath and legs with a long coarse grey pubescence. Length 12 lines.

This species comes nearest *S. devotus*, but is much more robust and has a nearly uniform colour and a woolly pubescence; the apices of the elytra in both are densely clothed with hairs, which almost entirely hide their outline.

Thysia viduata.

T. breviuscula, plumbeo-nigra; prothorace utrinque spinoso; apicibus elytrorum emarginatis; antennis apicem versus albidis; mesosterno producto.

Hab. Sumatra.

Much shorter than *T. Wallichii*, dark leaden black; head almost obsoletely punctured in front, a narrow raised line

between the eyes not extending to the clypeus; eyes larger than in *T. Wallichii*; prothorax rather narrow, not turgid, a stout, strong angular spine on each side; scutellum equilaterally triangular; elytra scarcely punctured except at the sides, their apices broadly emarginate, with five or six jet-black bands, the first at the base; body beneath black; legs with a purplish tinge; mesosternum with a large prominent mammillary process; antennæ with the third, fourth, and fifth joints plumose, the remainder dull white. Length 12 lines.

A comparatively short, nearly black species, remarkable for its strongly produced mesosternum. The other two species of this genus are *T. Wallichii*, Hope (Royle's 'Himalaya,' pl. 9. figs. 5 and 6), and *T. tricincta*, Lap. (Hist. Nat. des Ins. ii. p. 471), from Java. The latter has been hitherto confounded with Hope's species, from which it differs, *inter alia*, in having only a very small, scarcely noticeable tooth on each side of the prothorax.

Nyctopais Thomsoni.

N. **aterrimus, linea arcuata a vertice usque ad medium elytrorum, altera obliqua postica maculaque niveis; antennis niveo annulatis.**

Hab. Gaboon.

Intensely black, covered with a very thin and close pubescence, except where it is gathered up to form snowy-white markings—that is, a line from the mandible in front of each eye, another beginning on the vertex and passing back over the side of the prothorax above the spine, where it is joined to a patch below it, and then over the shoulder curving inwards to the suture, from which point it proceeds for a short distance longitudinally, near the apex an oblique line, directed inwards and downwards, which is followed by a small spot at the apex itself; beneath black and shining, with the episterna of the metathorax and a large spot on each side of all the abdominal segments white; upper portion of the posterior femora and two spots on their tibiæ white; a broad ring of white at the junction of the third and fourth joints of the antennæ, and another at the junction of the seventh and eighth. Length $5\frac{1}{2}$ lines.

In *Nyctopais mysteriosus*, Thoms., the only hitherto described species of the genus, the white markings are arranged very differently, as will be seen in the figure given in the 'Archives Entomologiques,' tom. ii. pl. vii. fig. 1. I have much pleasure in dedicating this new member of the genus to M. James Thomson, the author of that and so many other useful and indispensable works on entomology.

A short diagnosis of the following genus was given in the 'Proceedings of the Entomological Society' for February 1868, p. xiii. M. Lacordaire informs me (*in lit.*) that he considers it synonymous with *Lophoptera* of M. Perroud; but in this genus the antennæ are said to be distant at the base, and the third joint only "a little less long than the fourth and fifth together." These characters, taken in conjunction with its supposed affinities, do not apply to anything known to me; I have therefore ventured to give here a fuller description of the proposed genus, which was named

ANTHORES.

Head rather narrow above, nearly quadrate in front. Eyes not nearly extending to the mouth. Antennary tubers contiguous at the base, prominent and diverging. Antennæ in the male twice as long as the body, setaceous; scape very stout, with a well-marked cicatrix at the apex, and nearly as long as the third joint; this a little longer than the fourth, which with the three following are equal; the eighth to the tenth slightly shorter, the eleventh simulating two joints. Prothorax small, transverse, irregular above, a slender tooth on each side at the middle. Elytra elongate, subparallel, with a slight crest on the base of each; shoulders produced. Legs nearly equal, anterior tarsi neither dilated nor fringed. Pro- and mesosternum declivous; metasternum elongate.

The type is well known in collections under the name of *Monochamus leuconotus*, but it has never been published. The female differs slightly from the male in having the antennæ only about a third longer than the body. The genus is known from *Monochamus*, *inter alia*, by the basal crests of its elytra, the legs of nearly equal length, and the tubercular prothorax.

Anthores leuconotus.

A. fuscus, elytris, basi et plaga laterali postmediana exceptis, albo tomentosis; his, capite prothoraceque fusco pubescentibus, maculis fulvis vage intermixtis.

Hab. Natal.

Dark brown, with a dense white tomentum on the elytra, except at the base and patch at the side behind the middle, which, with the head and prothorax, have a dark brown pubescence indistinctly mingled with spots of fulvous; head deeply indented between the antennary tubercles; prothorax slightly transverse, two well-marked tubercles on the disk, a little before the middle; scutellum curvilinearly triangular; elytra impunctate, granulate at the base, between the scutel-

lum and shoulder a small granuliform crest; body beneath covered with a long brownish-fulvous pubescence, but whitish on the metasternum; femora darkish but fading to a pale colour on the tibiæ and tarsi; antennæ fulvous brown, base of all the joints, from the third inclusive, paler. Length 14 lines.

In the same Proceedings, *l. c.*, I proposed *Opepharus* as a generic name for *Monochamus tridentatus*, Chev.* (*signator*, Pasc.), differing from *Anthores* in its longer antennæ in the male (twice as long as the body), with the last joint subulate, the elytra strongly crested at the base, the fore legs of the male longer and more robust than the others, and the metasternum not elongate. *M. asperulus*, White†, should be referred to the same genus.

MISCELLANEOUS.

On the Marine Forms of Crustacea which inhabit the Fresh Waters of Southern Europe. By Prof. Heller.

Every one knows the curious discoveries made by Prof. Lovén upon the presence in the Wenern and Wetter lakes of animals identical with species belonging to the Frozen Ocean. The Swedish naturalist has adduced this identity as evidence in favour of the union of these lakes with the sea at a period anterior to history. These discoveries directed attention to the fauna of the lakes situated south of the Alps. As early as 1857, E. von Martens described a series of fishes and Crustacea which, although living in various Italian lakes, present the characters of Mediterranean species‡. Such are, amongst fishes, *Blennius vulgaris*, Pall., from the lakes of Garda and Albano, *Atherina lacustris*, Bon., from the lakes of Albano and Nemi, and, lastly, *Gobius fluviatilis*, Bon., from the lake of Garda and the neighbourhood of Padua,—and amongst the Crustacea, *Palæmon lacustris*, Mart., from the lake of Albano, *Thelphusa fluviatilis*, Latr., from the lakes of Albano and Nemi, and, lastly, *Sphæroma fossarum*, Mart., from the Pontine Marshes. These facts have already been employed by M. Sartorius von Waltershausen in his investigation of the climates of the present and of former periods. This *savant* endeavours to establish that the lakes situated south of the Alps were formerly in communication with the sea, and are only the remains of ancient fiords. Geological changes, by separating them from the sea, converted them into basins of brackish water, which were gradually deprived of their salt, with a rapidity differing according to the abundance of river-water flowing into them. These lacustrine

* Silbermann's Rev. i. No. 9, pl. 7.
† Proc. Zool. Soc. 1858, p. 411.
‡ See 'Annals,' ser. 3. vol. i. p. 50.

reservoirs were carried to a certain height by upheavals, which lowered the temperature of their surface. In the course of these events the marine fauna disappeared, with the exception of a few fishes and Crustacea less sensitive than their fellows to the action of fresh water.

Prof. Heller has carefully investigated the marine forms inhabiting the Italian lakes. He confirms and extends most of the discoveries of M. von Martens, at the same time rectifying some of them. He shows that *Palæmon lacustris* is a species very widely diffused in the fresh waters of the Mediterranean basin. He cites it in the lake of Albano, in the ditches of the *terra firma* in the neighbourhood of Venice, in the marshes round Pavia, in the lake Trasimene, in that of Garda, in the brooks of Dalmatia, in Corfu, in the lake of Albufera in Spain, and, finally, in Egypt. But this species is not peculiar to the fresh waters; it still exists in the North Sea and the Baltic. M. Heller, in fact, recognizes in it the species introduced into science under the names of *P. varians* and *P. antennarius*. It appears, however, to be wanting in the Mediterranean. M. Milne-Edwards certainly mentions it, in his 'Histoire Naturelle des Crustacés,' as occurring in the Adriatic; but the author himself has found this statement to be erroneous, the specimen in the Paris Museum having really been derived from Lake Trasimene. The crustacean in question is distinguished from all the Palæmons by the want of a palpus on the mandibles, by which it approaches the genus *Anchistia*. But as other characters distinguish it from that genus, M. Heller proposes for it the new generic name of *Palæmonetes* (*P. varians*). It is probable that this *Palæmonetes* existed at a prehistoric period in the Adriatic and Mediterranean, as at present in the bays of the North Sea, in places where the water was comparatively not very salt. Subsequently, after the transformation of the bays into lakes, the species gradually accommodated itself to the fresh water, although without attaining its original size. In fact the freshwater individuals are always smaller than the marine.

A similar lot may be reserved in the future for another crustacean of the Adriatic. *Nephrops norvegicus*, which is so common in the northern seas, occurs here and there in the Mediterranean and the Adriatic. In the Gulf of Quarnero, however, it exists in considerable quantity. If this gulf should one day be converted into a lake by an upheaval, this animal would, no doubt, in time become a true freshwater crustacean, whilst its congeners would still live in the northern seas.

Thelphusa fluviatilis is not entirely confined to the lakes of Albano and Nemi; it occurs also in the south of Italy, in Greece, in Cyprus, in the Crimea, in Syria, and in Egypt. As regards the *Sphæroma* of the Pontine Marshes, it presents the greatest resemblance to a species (*S. granulatum*) inhabiting the Adriatic and Mediterranean, although they cannot be completely identified.

Lastly, M. Heller describes two new freshwater Crustacea of marine forms. The first is an Amphipod (*Gammarus Veneris*) found by M. Kotschy in the Well of Venus, near Hierokipos, in Cyprus, at

an elevation of 50 feet. This species is almost identical with *Gammarus marinus*, from which it differs only in a clothing of hairs like that of other lacustrine species.

The second species belongs to the genus *Orchestia* (*O. cavimana*). It was found in great abundance by M. Kotschy in Cyprus, upon Mount Olympus, at an altitude of 4000 feet. It lives in moist places, in the vicinity of a spring. This species appears to differ from *O. Montagui* only by insignificant characters, such as a somewhat smaller size and a darker colour.—*Siebold & Kölliker's Zeitschrift*, xix. p. 156; *Bibl. Univ.* xxxv. June 15, 1869, *Bull. Sci.* pp. 158–160.

On the Leaves of Coniferæ.

By Thomas Meehan, of Germantown, Pennsylvania.

Botanists can scarcely have overlooked the fact that the true leaves of *Pinus* consist of bud-scales, and that what are known as leaves, and what Dr. Engelmann (Gray's Manual, 5th edition, p. 469) calls "secondary leaves" are but phylloid shoots; but I have failed to find any specific reference to the fact in botanical works. Dr. Dickson, however, in a paper "On the Phylloid Shoots of *Sciadopitys verticillata*" (Proceedings of Botanical Congress, 1866, p. 124), remarks, "In *Sciadopitys* I have to call attention to the fact that the leaves of the growing shoots consist, as in *Pinus*, entirely of bud-scales." One would suppose, from this incidental reference to *Pinus*, that he was acquainted with the fact that the so-called leaves of *Pinus* were phylloid shoots; but as the object of the paper is to show that the so-called leaves of *Sciadopitys* are not true leaves, and as any one must know that they are not if already cognizant of the fact in *Pinus*, we may take it for granted that at any rate, if not entirely overlooked, little thought has been given it. I believe I am occupying an entirely original field in pointing out the true nature of leaves in *Coniferæ*, and that the increased knowledge will have an important bearing on many obscure points in their study.

Dr. Dickson uses but the language of general botany when he describes the true leaves of *Pinus* as "bud-scales," meaning thereby the scaly free portion just under the "secondary leaves" of Engelmann, and sometimes forming sheaths around them. But these free scales are scarcely leaves. The chief portion of the true leaves in most plants of the order are adnate with the stem; sometimes they have the power to develope into scaly points, at others into foliaceous tips, and at other times are without any power but to preserve their true leaf-like character. *Larix* affords the best illustration. The true leaves are linear-spathulate, entirely adnate to the stem. There are two kinds of stem-growth in *Larix*: in the one case the axis elongates and forms shoots; in the other, axial development is arrested and spurs are formed. On the elongated shoots the leaves are scattered; on the spurs they are arranged in whorls. The power of elongation possessed by the shoot is imparted to the leaves which are adherent to it, and they produce green foliaceous awl-like tips: the power of elongation which the spurs have lost is also measurably

lost to their leaves: they develope themselves fully, although they have no stem to adhere to; they preserve the spathulate form, but cannot produce the awl-shaped tips of the shoot-leaves. There are, therefore, two forms of leaves on the larch, the one free, the other adherent; and we have a novel principle very clearly illustrated, that *strong axial development* (vigour) *is a characteristic of adhesion, while the reverse* (weakness) *is characterized by a free system of foliation.* Any species of *Larix* will sustain this observation; and *leptolepis*, as a vigorous grower, is the best.

The characteristics of the foliage described in *Larix* may be found in a greater or less degree in a great many species of coniferous plants. In *Cryptomeria* the leaves adhere for four-fifths of their length on vigorous shoots; but on the more delicate ones they are free for three-fourths or more. In *Juniperus* the different forms of foliage are well known, especially in *J. virginiana*, *J. chinensis*, and *J. communis*. On the vigorous shoots adhesion takes place for nearly the full length of the leaves; but on weaker ones the leaves are very nearly free. In *Thuja*, *Biota*, *Retinispora*, *Cupressus*, *Thujopsis*, indeed most of the section *Cupressineæ*, these variable degrees of adhesion may be found, and always in relation to the absence or presence of vigour: and on this question of vigour it will be well here to make a few remarks. The power to branch I take to be a high mark of vigour. The young seedlings of most coniferous trees grow but a few inches the first year, and have no power to branch; the power increases with age, and in all cases in proportion to the vigour of the plants. In *Thuja*, for instance, no branches appear till the second year; they increase in number, until, when in its prime, branches appear from every alternate pair of axils, and, as these are decussate, this gives the fan-like form of growth of which the *Arbor vitæ* affords a familiar illustration.

This varying power of adhesion in the true leaves, and in connexion with vigour, enables us to explain many matters hitherto not understood. For instance, Dr. Lindley describes a form of *Biota* as *B. meldensis*, suggesting that from its appearance it must be a *hybrid between the red cedar and Chinese Arbor vitæ*; it is but *B. orientalis* with the leaves moderately united. *Thuja ericoides* of gardens was long supposed to be a Japanese species; it is but an entirely free-leaved form of *Thuja occidentalis*. *Retinispora ericoides* of Zuccarini is but a free-leaved form of some Japanese plant; and in all probability many species of *Retinispora*, so marked in herbariums, are all forms of one thing with more or less adnate leaves. In all these cases delicacy of growth and freedom of leaves go gradually together, as before indicated.

One of the most remarkable instances of the value of this principle, however, will, I have no doubt, be in fixing the identity of the Japanese genus *Glyptostrobus** of Endlicher with the American *Taxodium* of Richard. In a shoot one foot in length of the latter we find perhaps four or six branchlets; in the same space in *Glyp-*

* *Note by the proof-reader.*—It was the intention of the author to refer his remarks on *Glyptostrobus* to *G. sinensis*, Endl.

tostrobus we shall find a score or more. Indeed in this plant a branchlet springs from nearly every axil on the main branch, showing an extraordinary vigour. As vigour is opposed to a free development of foliage, the small thread-like leaves of *Glyptostrobus* are naturally to be expected, and the free leaves distichously arranged is the natural concomitant of the weaker *Taxodium*. Fortunately I am able to sustain this theory by actual facts. I have a seedling tree ten years old, of remarkable vigour. It does not branch quite as much as the typical *Glyptostrobus*, but much more freely than any *Taxodium*. The result is, the foliage is aciculate, not distichous, and just intermediate between the two supposed genera. But to help me still more, my tree of *Glyptostrobus* has pushed forth some weak shoots with foliage identical in every respect with the intermediate *Taxodium*. Specimens of all these are presented with this. In establishing *Glyptostrobus*, Endlicher notes some trifling differences in the scales of the cones between it and *Taxodium*; but all familiar with numerous individuals of some species of Coniferæ, *Biota orientalis* for instance, know how these vary. There can be no doubt, I think, of the identity of the two; and this will form another very interesting link in the chain of evidence that the flora of Japan is closely allied to that of the United States.

If we were to look on the so-called leaves of *Pinus* and *Sciadopitys* as true leaves, we should find serious opposition to my theory that a vigorous axial growth is opposed to the development of free leaves in Coniferæ; for we should see a class of plants which notoriously adds but from three to six branches annually to each axis clothed with foliage. But admitting them to be phylloid shoots, it confirms our theory in a strong degree. We then see a plant loaded with branchlets; and so great is the tendency to use them instead of leaves, that in some cases, as in *Pinus strobus*, *P. excelsa*, and others of a softer class of Phylloideæ, the bud-scales are almost entirely confined to the sheathing leaflets—just as in the very rugged, hard-leaved, almost spinescent forms, like *Pinus austriaca*, we find them more dependent on well-developed adnate leaf-scales. In *Abies* of old authors, *A. excelsa* for instance, we have a numerous-branching tendency; hence we have true leaves, though partially adnate, and no necessity for phylloid branchlets. In *Picea* of Link, almost near *Abies*, taking *P. balsamea* as a type, we have a rather weaker development, slower-growing and less hardy trees, and the leaves are nearly free. Could some of the shoots of *Abies* be arrested in their axial development, as in *Larix*, we should have the remainder increased in length, and the fewer branchlets and two forms of leaves just as in *Larix*. Should, on the other hand, the plant increase in vigour, there would be no class of free leaves, adnation would be the law, and metamorphosed branchlets prevail. Starting from *Abies*, extra vigour makes the pine, extra delicacy the larch; it is the centre of two extremes.

That the fascicles in *Pinus* are phylloid shoots, I think cannot be questioned. Their position in the axils of the true leaves, as beautifully shown in *Pinus austriaca*, indicates the probability; their per-

manency in proportion to their induracy is also another strong point. The soft ones of the *Strobus* section retain vitality little longer than some true leaves, while the spinescent ones of *P. austriaca* remain green for four or five years. But the strongest of all points is, that on dissection of an old fascicle, it will be found to have a distinct connexion with the woody system of the tree, and that these minute woody axillæ under each fascicle increase in size with the age of the sheath. With a very little encouragement these woody axillæ can be induced to elongate and become real branchlets. If the leading shoot, for instance, of a pine be tipped in May just after pushing, bulblets will form in every fascicle below, and the next season the bulblets will produce weak branchlets, although this might be said of true leaves, which are supposed to bear an embryo shoot in the axil of every one. So much stress need not be put on this fact, as the others are sufficient; it is introduced, and its weak nature commented on, as it furnishes the chief point in Dr. Dickson's argument for *Sciadopitys*, which amounts to little more than that the apparently single phyllon is really a double one—a two-leaved fascicle united by a transformed sheath through its whole length. Carrière has since pushed Dr. Dickson's observations further by noting, in the 'Revue Horticole,' really bifid leaves, with little verticils in the axils (see reference in 'Gardeners' Chronicle,' May 2, 1868)—an observation which I confirm by a specimen exhibited herewith; yet, as I have said, it is by itself not wholly free from the objection that it may be but a modified form of regular bud-growth; but, together with my other observations, I think they do serve to confirm the point of these so-called leaves being but phyllodea.

In conclusion, I will restate the main points of this paper:—

The true leaves of Coniferæ are usually adnate with the branches.

Adnation is in proportion to vigour in the genus, species, or in the individuals of the same species or branches of the same individual.

Many so-called distinct species of Coniferæ are the same, but in various states of adnation.—*From the forthcoming volume of the Proceedings of the American Association for the Advancement of Science.* (Communicated by the Author.)

Mechanical Reproduction of the Flight of Insects. By M. Marey.

The author has already shown that by gilding the tips of the fore wings of a hymenopterous insect and allowing it to fly in the sun, the point of each wing is found to describe a figure of 8, indicating that in the course of one elevation and descent the wing moves twice forward and twice backward. To ascertain how this movement is produced, the author took a small glass rod blackened with smoke, and by presenting it to the wing in different parts of its passage, he found that the soot was rubbed sometimes on the upper and sometimes on the lower surface, according as the rod was held below or above the course of the wing forwards or backwards. From

his experiments he concludes that the wing moves from behind forwards both in its descent and in its ascent.

That the plane of the wing changes twice during each movement appears from the difference in the brilliancy of the two branches of the luminous figure of 8. When a branch is very brilliant, this is because it presents its gilt surface at a favourable angle for the reflection of the sun's light. During descent the wing presents its upper surface a little forward, whilst during elevation this surface looks rather backward.

These movements are so complex that they would require a very complex muscular apparatus if each of them was the result of a special act. It would require a very perfect coordination to enable these eight or ten successive actions to be reproduced in regular order at each revolution of the wing—that is to say, from two hundred to three hundred times in a second; but the simple elevation and depression of the wing is sufficient to enable the resistance of the air to produce all the other movements. The wing being rigid in front, in consequence of its thick nervures, the flexible hinder part, being raised by the resistance of the air during the rapid depression of the wing, will acquire an oblique direction, so that the upper surface of the wing will look forward; on the other hand, during elevation the resistance of the air will be above, and the upper surface of the wing will incline backwards. This figure-of-8 movement exactly resembles the motion of the oar in sculling a boat.

To verify his theory, the author has constructed a small apparatus, which he describes as follows:—A mechanism set in motion by an air-pump caused the alternate elevation and depression of a pair of wings constructed on the plan of those of insects. This apparatus had not sufficient motive power to raise its own weight; but it was placed upon a pivoted rod in equilibrium, so that, if the apparatus developed the motive power required by the theory, the whole would acquire a movement of rotation round a central axis. On being set in action, the apparatus rotated rapidly.

By gilding the tip of one of the wings of this artificial insect, all the movements and changes of plane executed in the flight of an insect were reproduced by the apparatus; and as the force derived from the pump can only produce elevations and depressions of the wing in the same plane, it is evident that the other movements are produced by the resistance of the air.

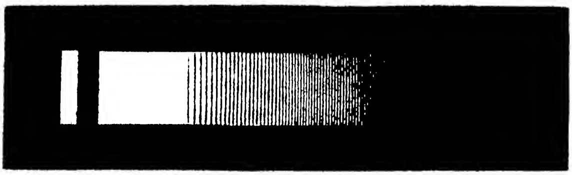
The origin of this theory of flight is to be found in Borelli, who supposes that the wing of a bird acts upon the air in the manner of a wedge. Strauss-Durckheim states this opinion more clearly, and shows how the insect derives, from the resistance of the air to the inclined plane of its wing, a combination which it employs to sustain and guide itself. Girard has made experiments to show the correctness of Strauss-Durckheim's hypothesis, and proved that if the flexibility of the hinder margin of the wing be altered by a dry coating of any kind, the power of flight is destroyed.—*Comptes Rendus*, March 15, 1869, tome lxviii. pp. 667–669.

Spectroscopic Examination of the Diatomaceæ. By H. L. Smith.

The vegetable nature of the Diatomaceæ is now generally admitted; but if any further proof is needed, we have it in marked results from the application of the spectroscope. I have been enabled to prove the absolute identity of *chlorophyl* or the green endochrome of plants with *diatomin* or the olive-yellow endochrome of the Diatomaceæ. The spectrum-microscope is now too well known to need any description here. The one I have used was made by Browning of London. It is not at all difficult to obtain a characteristic spectrum from a living diatom, and to compare it directly with that of a desmid, or other plant.

I need not here give the results in detail. Suffice it that, from about fifty comparisons of spectra, I can unhesitatingly assert that the spectrum of chlorophyl is identical with that of diatomin.

The spectrum in question is a characteristic one, and is figured below.



A very black narrow band in the extreme red, reading at the lower edge, which appears to be constant, about $\frac{7}{8}$ of Mr. Sorby's scale, is too characteristic to be mistaken. There are two other very faint bands, not easily seen, and somewhat more variable in position. The black band in the red is always present, and is remarkably constant in the position of its lower edge. In making comparisons of spectra it is of the utmost importance that the slit of the spectroscope should be absolutely in the focus of the achromatic eye-lens. If this be not attended to, there will be a slight parallax; and bands really identical in position, *e. g.* those of blood (scarlet cruorine), will not absolutely correspond when two spectra are formed, one from blood on the stage of the microscope, and the other from the same on the stage of the eye-piece.

The dark band of the chlorophyl-spectrum is slightly variable in width; and the action of acids and alkalies sometimes causes a slight displacement, the former raising (moving toward the blue end) and the latter depressing. The endochrome of a diatom after treatment with acid is green, and the acid, in this case, produces scarcely any displacement of the band, which may be observed even in the dark reddish mass of the dead Diatomaceæ, almost identical in colour with the ferrous carbonate so often found in bogs where the larger diatoms are abundant; and what is more remarkable is, that the carbonate gives no absorption-bands at all. As a general rule, alcoholic solutions of chlorophyl and diatomin have the band slightly depressed, reading 1 to $1\frac{1}{2}$ on the interference scale.—*Silliman's American Journal*, July 1869.

Two new Generic Types of the Families Saprolegnieæ *and* Peronosporeæ. By MM. E. Roze and M. Cornu.

The authors remark that it is questionable whether the Saprolegnieæ should be referred to the algæ or the fungi. They think that one of their new genera furnishes an argument in favour of the latter. It is an endophyte, parasitic upon the smallest of our phanerogams, *Wolffia Michelii*, Schleid. (*Lemna arrhiza*, Linn.), and presents some characters belonging both to the Saprolegnieæ and Peronosporeæ, so that it may to a certain extent be regarded as intermediate between the two families. They name it *Cystosiphon pythioides*.

Its mycelium, which traverses the cells of the *Wolffia* by perforating their walls, developes the two kinds of reproductive organs (sexual and asexual) which have already been indicated in the species of this family. The first mode of reproduction terminates in the formation of an oospore, the thick epispore of which resembles that of the oospores of the Peronosporeæ. This oospore originates here, however, from the fertile union of the antheridian and oogonic plasma, effected by means of a short process emitted by the antheridium, which penetrates into the oogonial cavity.

The so-called *asexual* reproduction of *Cystosiphon* is effected by means of zoosporangia. These are represented by vesicles which terminate certain branches of the mycelium in peripheral cells of the *Wolffia*. When mature, each of these vesicles, which is isolated by a septum from the rest of the mycelium, emits a tube which runs perpendicularly to meet the cellular wall separating it from the water. This flattens itself against the cellulose membrane, which it perforates by an exosmotic action, and then grows out into the water until its extremity becomes stationary and slightly thickened. The plasma of the zoosporangium is then instantaneously diffused in this extremity of the tube in the form of a plastic spheroid, which in a few minutes contracts and shows a very delicate enveloping membrane continuous with the tube. The following phenomena are then rapidly witnessed in the interior of this vesicle:—A network of clear lines indicates the segmentation which takes place in the plasmic mass, and the cilia appear; the segments separate from each other and constitute the zoospores; these agitate their cilia, and move more and more rapidly; lastly a portion of the wall of the vesicle becomes absorbed and the zoospores escape. Their movements last for about half an hour; they then become spherical, lose their cilia, become clothed with a membrane, and germinate by emitting a tube. This germinative tube then penetrates by perforation into the cells of healthy fronds of *Wolffia*, where it is developed into a mycelium.

The Peronosporeæ, to which the second new generic type belongs, have hitherto included only the genera *Cystopus* and *Peronospora*. The endophytal fungus, parasitic on *Erigeron canadense*, Linn., described by the authors under the name of *Basidiophora entospora*, is distinguished at the first glance from the above genera by its

conidiophorous stipites, which resemble the basidia of the Hymenomycetes.

The conidia, or asexual reproductive organs of *Basidiophora*, when placed in water at their maturity, present the remarkable fact that their plasma, instead of being expelled before the complete formation of the zoospores, undergoes its whole sporogonic evolution within them. The zoospores move in the conidia until the apical papilla of the latter, becoming absorbed, leaves them a passage into the liquid. This aperture, however, being much too narrow for the free passage of the zoospores, they pass it, one after the other, with great difficulty, by lengthening and twisting themselves with a most singular power of vitality. After their escape they traverse the liquid with considerable rapidity, but in less than an hour they stop and germinate.

The organs of sexual reproduction in *Basidiophora* are formed in the parenchyma of the leaves which have already presented the conidiophorous stipites. But this parenchyma, being formed by a very compact cellular tissue, does not allow us to ascertain clearly the relations of the antheridia and oogonia, or to observe the phases of fecundation.—*Comptes Rendus*, March 15, 1869, tome lxviii. pp. 651–653.

On Spatangus Raschi, *Lovén.*

At the meeting of Scandinavian naturalists at Christiania, in July 1868, Prof. Lovén exhibited specimens of this new species, which was first discovered on the deep sea-bank of Storegzen, off the coast of Norway, as far back as 1844, by Prof. H. Rasch, of the University of Christiania. Since that time it has been found occasionally in the same locality, and Mr. Gwyn Jeffreys has dredged it in the Zetland seas. From the *Spatangus purpureus* of O. F. Muller, which it almost surpasses in size, it differs by its more oblong and posteriorly more attenuated form and greater height, by much narrower petala, by the flattened ventral surface, the prominent lip, the narrow strongly keeled sternum, of almost equal breadth throughout, and by the rounded, not bilobate, area semitalis, half as large as that of *Spatangus purpureus* of the same size. The colour is dark reddish brown; and the primary spines, arranged, as in *Sp. purpureus*, in arcuate series, are shorter than in that species.

At the same time, Prof. Lovén drew attention to the fact that, in very young specimens of Spatangidæ, the peristomium, situated much nearer the middle of the body than in the full-grown animal, is exactly pentagonal, with the mouth, an oval opening in its centre, surrounded by perforated plates of an irregular form. But the mouth is very soon drawn backwards, and becomes transversely elongated, the surrounding plates assuming their specific shapes; and when the mouth has reached the posterior side of the peristomial pentagon, this side begins to protrude forwards and to develope into the vaulted lip peculiar to the Spatangidæ. This juvenile pentagonal form of the peristomium is retained by the full-grown individual in *Palæostoma* and in certain fossil forms, as *Echinospatangus*, *Holaster*, and others.—*Communicated by* Prof. Lovén.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 22. OCTOBER 1869.

XXV.—*On some curious Fossil Fungi from the Black Shale of the Northumberland Coal-field.* By ALBANY HANCOCK, F.L.S., and THOMAS ATTHEY*.

[Plates IX. & X.]

IT is now about ten years ago that a few sections of certain lenticular bodies were made and their peculiar tubular ramifications revealed. These bodies were then supposed to be of vegetable origin, and were procured in the Cramlington Black Shale. At the time we took these tubular ramifications to be those of a parasitic fungus related to the unicellular fungi described by Kölliker †; and as such our specimens were exhibited at one of the early microscopic soirées held by the Tyneside Naturalists' Field Club.

Since we first became acquainted with these curious and interesting bodies, we have collected a vast number of specimens (not less than 150) at Cramlington, Newsham, and other localities; and, having been engaged for the last few months investigating the subject, we now propose to give a succinct account of the results at which we have arrived, reserving for some future occasion more complete details of our researches.

First, then, with regard to the bodies themselves in which the peculiar structure alluded to is found. They are frequently circular, a good deal depressed and lenticular, with one side generally flatter than the other, sometimes quite flat. The largest are upwards of $\frac{4}{10}$ inch in diameter and nearly $\frac{3}{10}$ inch in thickness. Oval, depressed forms also occur, one of which in our possession is $\frac{8}{10}$ inch in length, though one extremity is wanting, and $\frac{7}{10}$ inch wide. But by far the greater number

* Communicated by the Authors, having been read at the Meeting of the British Association held at Exeter in 1869.

† See Ann. & Mag. Nat. Hist. ser. 3. vol. iv. p. 300, Oct. 1859.

are somewhat irregular in form, mostly partaking, however, of the circle or ellipsis: one such elongated specimen is an inch in length. Some have the margin a little sinuous; others are even pedunculate, or at least have a narrow produced process at one end; and it is not uncommon to find them very much flattened, squeezed out as it were, till the margins are quite sharp. The surface is invariably dull and much like the matrix in texture, though in one or two instances we have perceived indications of a reticulated structure. They leave the matrix with great facility, frequently dropping out of it on the shale being split open.

When sections of these bodies are viewed by transmitted light, they vary in colour from carmine to warm yellow, resembling much in this respect fossil wood from the same locality, though the latter is never so bright in tint. Like fossil wood, too, the sections have a tendency to warp when placed on the slide, and consequently the outer margin or rim is frequently cracked all round on putting on the cover.

That they are non-calcareous is proved by a very simple experiment. If we place a fossil tooth or bone from the Newsham Shale in dilute nitric acid, a violent effervescence immediately ensues, and the result is that in an hour or two the specimens are either entirely broken down or are so much reduced that they crumble to pieces on being touched with the finger; hence it is evident that such fossils from the abovementioned locality retain their calcareous matter not much, if at all, changed. Now when we treat one of the lenticular bodies in question with nitric acid of the same strength, no action whatever takes place, and after being immersed in it for several hours no perceptible effect is produced. Fossil wood from Newsham Shale is likewise unaffected when subjected to the same influence. We have thus a proof that these lenticular bodies are non-calcareous, and strong presumptive evidence as to the probability of their being of vegetable origin*.

Indeed that they are so does not admit of a doubt. If there were no other evidence of the fact, it is demonstrated by their organic structure. Originally, as already stated, we took this organic structure (the tubular ramifications) to be a parasitic fungus, and the substance in which it was imbedded to be wood. And assuredly the tubular ramifications resemble very closely those of the unicellular fungi before alluded to, many species of which we have in our possession. The size and general character of the tubes, the mode of ramification, and

* Some account of these lenticular bodies has recently been given, in 'Scientific Opinion,' by Mr. T. P. Barkas, who supposed them to be fish-otolites.

particularly their bulbous enlargements, all agree very well with what we observe in these peculiar bodies. But there is one important difference: while, in the unicellular fungi, the tubes never sink deep into the substance in which they are lodged, ramifying immediately below its surface, those of the lenticular bodies, though they are connected with the periphery, permeate the entire mass. Our recent investigations, however, compel us to the conclusion that the whole, including the substance in which the tubes ramify, is but one organism, and that it is a fungus of a peculiar nature, related apparently in structure, and to some extent in form, to *Sclerotium stipitatum*, a very curious and abnormal species from India, described by Messrs. Berkeley and Currey in the 'Transactions of the Linnean Society' (1862, vol. xxiii. pp. 91 & 93). The internal structure of this living species is so similar to that of some of the coal-fungi in question, that, were it fossilized, it would assuredly be considered one of them. "The mass consists," says the Rev. M. J. Berkeley, "of very irregular, swollen, and sometimes constricted, more or less anastomosing and more or less densely compacted threads." These words might be used to describe the tubes of *Archagaricon conglomeratum*, one of our fossil fungi described in the sequel.

We have in our possession a section of *Sclerotium stipitatum*, and, after carefully examining it, we can find no important difference distinguishing it from sections of our coal-fungi. The irregular character of the tubes, their nodular enlargements, and the large terminal vesicles are all features that are found in both the recent and fossil species. And, moreover, many of the larger "threads" or tubes in *Sclerotium stipitatum* can be seen abutting with their ends against the dark peripheral cuticle, just as the tubes do in the fossil species, the bark or cuticle of which is similar in definition and thickness, and is also dark and opaque*.

On examining sections of these lenticular fungi from the coal-shale, we find that they occasionally appear to be almost, if not entirely, homogeneous, and that, when perfect, they al-

* Since the above was written, we have obtained from Newsham a very interesting specimen of our new fungus, with the surface in excellent preservation. We have stated in the text that traces of surface-reticulation had been observed; in this new specimen the whole surface is covered with a minute angular reticulation, sharply defined by grooves, and resembling most closely the cuticular reticulation represented in the figures of *Sclerotium stipitatum* illustrating the paper of Messrs. Berkeley and Currey already referred to; so that in general form, in this peculiar surface-reticulation, in the thickness and character of the cuticle, and in internal structure our fossil fungi agree with this peculiar species from India.

ways exhibit a peripheral bark or cuticle of considerable thickness, though they vary in this respect, the cuticle being sometimes comparatively thin. The colour, as before mentioned, varies from a pretty clear carmine to a warm yellow, the intensity, of course, varying with the thickness of the section, and also, to some extent, the tint. But the apparent homogeneity is not by any means constant; indeed by far the greater number of specimens show the peculiar structure before mentioned, some to only a slight degree, others very extensively, the whole mass being filled with, nay, almost composed of, ramifying tubes. The tubes vary considerably in size in the different species (for there are many species of these fungi), and, in fact, to some extent in the same species. In some they measure $\frac{1}{800}$ inch in diameter; in others they are quite minute, being only $\frac{1}{15000}$ inch in diameter; in some they are plain; in others, again, they terminate in large bulb-like swellings, and have here and there similar but smaller enlargements, two or three of such being occasionally placed close together. The tubes always appear to originate in the peripheral cuticle.

The mode of ramification also varies: in some species the tubes are long, and may be said to branch rather freely; but in others they are cramped and much contorted; they are usually inextricably involved; and in a few instances they radiate from centres, and are short, sinuous, and stout. In all cases they terminate in rounded extremities when not in bulbs.

The branches are very frequently sharply defined, and exhibit a double marginal line, indicating that they have proper walls. They are occasionally filled with the matrix; and then they are black and perfectly opaque, and have a very striking appearance. The contained black matter is continuous with the external matrix, and from this fact it may be inferred that the tubes open externally; indeed their arrangement seems to indicate this; however, they are usually transparent, and reveal within their walls oval spore-like bodies, which pervade both the branches and the bulbous enlargements. Similar spore-like bodies are frequently scattered through the substance of the fungus amidst the ramifications; and in a few specimens in our possession these spore-like bodies are thickly scattered throughout the entire substance, no tubes or any other structure being perceptible. In others, again, nothing is observed in the homogeneous matter except circular vesicles resembling the bulbous enlargements of the tubes; in some instances such vesicles, large and small, are mingled together, and have scattered amidst them the spore-like bodies. In one

remarkable specimen the vesicles seem to be formed into a connected congeries towards the margin.

Another variety of these curious fungi has the outer bark or cuticle rather thick; and it seems to be composed of two or three layers. Immediately within the innermost layer there is a thin stratum of minute granules, which in some specimens is much extended, and the granules enlarged. In the former the quarter-inch object-glass is requisite to resolve them; in the latter an inch glass shows them very well. And, what is rather peculiar, at certain points of the circumference the bark or cuticle is folded inwards, the *outer* layer to a much less extent than the *inner*, thus leaving a wide space between the two. These inward foldings, of which there are three or four, bulge considerably into the substance of the fungus, and are somewhat reniform or ear-shaped. The stratum of granules follows the infoldings with the greatest regularity.

There is still another variety, which differs considerably from all the rest. This is without tubes, the whole substance being composed of large polygonal cells having the appearance of coarse cellular tissue, with here and there a dark, irregular, spherical body.

Such are the variations in the structure of these Coal-measure fungi: they are, we have said, occasionally structureless or nearly so; but this is rarely the case. We have sixteen specimens that appear either homogeneous or almost so, out of 126 sections, all the rest (110) exhibiting more or less structure. This fact militates strongly against the idea we at first entertained, that the tubular structure was a fungus parasitic in the bodies in which it is found. Were such the case, these figures ought to be reversed: 16 bodies so affected might be found in 126; but certainly we should never expect to find out of that number 110 affected and 16 only free from the parasite.

The apparent entire homogeneity of some specimens, and the apparent partial homogeneity of others, can be accounted for as the result of fossilization. Fossil wood and other vegetable substances have frequently the structure either wholly or partially obliterated by pressure. This is not uncommonly the case with wood found in the Newsham Coal-shale; and it can scarcely be doubted that such is the case with the fungi in question. We presume that the general substance of these bodies is composed of cellular tissue (and, indeed, in one of the varieties above mentioned we have seen that it is chiefly made up of cellular tissue, and traces of such a structure have been observed in one or two other instances), and that by pressure this is almost universally obliterated. The ramifying tubes,

with the spore-like bodies, being of a less delicate nature, or in some way less perishable, are sometimes preserved throughout the mass, at other times only partially preserved; occasionally the tubes are so strongly defined, that every characteristic is retained; again so delicate and attenuated are they, that their margins only can be perceived, dying out until the faintest traces of them subside into the surrounding homogeneous substance.

Those specimens that exhibit only cell-like bodies, large and small, may have had likewise ramifying tubes, and pressure may have obliterated them; or they may have had a continuous connected congeries of cells opening at the surface, as the tubes would seem to do; and in one instance, at least, extensive traces of such a structure exist. In this case the spores will have been developed in the cells; and, in fact, spore-like bodies have been observed in connexion with these cells.

We have already stated that the tubes originate in, and apparently open at, the periphery of the fungus, and that spore-like bodies are occasionally found within the tubes and the bulbous enlargements in connexion with them. Such being the case, it is only necessary to suppose (and, indeed, from what we have seen, apparently the fact is such) that the tubes are invaginated prolongations of the outer envelope or cuticle, in order to bring the organization of these coal species into some accordance with the structure of the higher fungi, in which the spores seem to be always developed in connexion with folds, tubes, or processes of one kind or other of the enveloping membrane or cuticle, or, more correctly speaking, of the hymenium, which is itself apparently a continuation of the peripheral investment.

We shall now conclude this very imperfect account of these interesting Coal-measure fungi with concise descriptions of a few of the more characteristic species, leaving the rest (probably as many more) for further investigation, which we hope will throw additional light on this intricate subject.

DESCRIPTIONS OF SPECIES.

1. *Archagaricon bulbosum.*

Tubes of equal size, about $\frac{1}{1000}$ inch in diameter; the main branches pretty straight, long, somewhat sinuous, with the secondary branches much contorted, involved, and crowded; occasionally papillose, and frequently terminating in large spherical vesicles, and with smaller bulbous enlargements, sometimes two or three in close succession, their diameter

being three or four times that of the branches, the terminal vesicles being much larger.

Several specimens of this species have occurred; and we have two or three of what we consider to be a variety of it, with similar branches; but neither have they bulbous enlargements nor are they papillose. The peculiarities of this variety are probably owing to its state of development.

2. *Archagaricon globuliferum.*

Tubes various in size, the larger about $\frac{1}{2000}$ inch in diameter, smooth; both stems and branches straight or very little sinuous, with numerous globular enlargements five or six times the diameter of the tubes, and with a few extremely large spherical vesicles, many times larger than the globular enlargements, some of them being $\frac{1}{50}$ inch in diameter.

This species is distinguished from *A. bulbosum* by the straightness, smoothness, and minuteness of the branches, and also by the more numerous globular enlargements, and particularly by the great size of the terminal vesicles. Several specimens have been obtained.

3. *Archagaricon radiatum.*

Tubes large, measuring $\frac{1}{800}$ inch in diameter, short, smooth, a little tortuous, and appearing as if radiating from centres, but not with much regularity; their margins are not always exactly parallel, but usually somewhat irregularly sinuous.

This is a very characteristic species, and cannot be confounded with any other. We have two specimens exactly agreeing in the above characters; a third has, in addition to the radiating tubes, large, irregular, rounded vesicles. The variation is probably owing to a different state of development. The fungus is elongated and rather small.

4. *Archagaricon dendriticum.*

Tubes very minute, $\frac{1}{15000}$ inch in diameter, arranged in dendritic tufts in connexion with the periphery of the organism, and having interspersed large elliptical vesicles, which are apparently terminal. When the branches are crowded, the tuft-like arrangement is obscured.

We have only two specimens of this pretty species; they are irregularly circular, and are quite minute, being only $\frac{1}{10}$ inch in diameter. They do not exactly agree in internal structure, one of them having the terminal elliptical vesicles much more numerous than the other, and the organism crowded throughout with a vast number of similar vesicles.

5. *Archagaricon conglomeratum.*

Tubes large, uneven, cramped, and warty, irregularly enlarged and occasionally much constricted, anastomosing, and studded with cells of various sizes, sometimes so numerous that the tubes are much obscured, the whole mass appearing filled with them.

Several specimens have occurred of this well-marked species. The tubes are occasionally constricted to $\frac{1}{800}$ inch in diameter, and are sometimes enlarged to considerably more than twice that size. They are of an irregular form.

EXPLANATION OF PLATES IX. & X.

Plate IX.

Fig. 1. Lenticular form of *Archagaricon.*
Fig. 2. Oval form.
Fig. 3. Irregular elongated form.
Fig. 4. Pedunculate form.
Fig. 5. Irregular form, with minutely reticulated surface.
Fig. 6. A portion of the surface, enlarged, to show the reticulations.
Fig. 7. Transverse section of lenticular form.

Plate X.

Fig. 1. General view of a few of the tubes, much enlarged, of *Archagaricon bulbosum*: *a*, peripheral envelope or cuticle of the fungus; *b*, one of the large terminal vesicles; *c*, tubular enlargement.
Fig. 2. A portion of a tube of the same species, more highly magnified, with a terminal vesicle, showing the double marginal line.
Fig. 3. An enlarged portion of a tube, with bulbous swelling and papillose walls.
Fig. 4. The same, showing spore-like bodies within: *a*, spore-like bodies.
Fig. 5. Terminal extremities of three tubes without enlargements, showing double marginal line.

XXVI.—*Descriptions of a new Genus and two new Species of* Scyllaridæ *and a new Species of* Æthra *from North America.* By Sidney I. Smith*.

Evibacus, gen. nov.

Carapax very broad; lateral border expanded, incision at the cervical suture closed, and the margin behind it not incised. Rostrum broader than long, very slightly bilobed. Eyes situated midway between the rostrum and the outer angle; the orbits entire, slightly removed from the anterior margin and connected with it only by a suture. Antennæ with the inner margins approximate.

* From Silliman's American Journal, July 1869.

This genus is most nearly allied to *Ibacus* and *Parribacus*, but is very distinct from both of them in the entire lateral margin of the carapax, the closing of the orbits in front, and the form of the rostrum.

Evibacus princeps, sp. nov.

Whole upper surface verrucose and nearly naked; five low, tuberculose elevations on the median line of the carapax, of which one is at the base of the rostrum, two on the gastric region, one on the anterior part of the cardiac, and one on the posterior margin; similar elevations on the middle of the second and third segments of the abdomen, and a very slight one on the fourth. Carapax strongly convex transversely; the anterior margin nearly straight, except at the lateral angle, where it is slightly curved forward; lateral margin strongly curved, with a broad notch at the cervical suture, behind which the margin is very slightly obtusely and irregularly toothed. Antennæ together as broad as the anterior part ot the carapax; the outer margins coarsely and irregularly serrate and their outline forming the segment of a circle. Everywhere beneath naked and nearly smooth. External maxillipeds with the outer margin of the merus divided into a number of slender processes. Legs so short that when bent forward in their natural position they are concealed beneath the expansions of the carapax; those of the first and second pairs with the superior angle of the merus raised into an obtuse crest; dactyli of all the legs short and stout, in the female those of the posterior pair closing against a process from the propodus. Abdomen with the lateral projections of the second, third, and fourth segments long and rather acutely pointed, those of the fourth shorter and triangular at tip; lamella of the terminal segment half as long as broad. Whole length of body 14 in.; length of carapax, including rostrum, 5·8; breadth of carapax 7·9.

A single female specimen of this remarkable species, the first of the Scyllaridæ discovered upon the west coast of America, was sent from La Paz, Lower California, by Capt. Jas. Pedersen.

Arctus americanus, sp. nov.

Carapax as broad as long, median crest high, covered with low squamiform tubercles, tridentate, the anterior tooth small and situated halfway between the front and the second tooth; lateral crests very high, anterior portion with two teeth above the eye and separated by a deep notch from the posterior portion, which is covered to the lateral margin with low squamiform tubercles; depression between the median and lateral

crests broad and deep, smooth or slightly punctate, with a median line of four depressed tubercles; lateral margin broken by a deep fissure at the cervical suture, and by a slight one a little more posteriorly. Antepenultimate segment of the antennæ as broad as long; anterior angle not prominent; outer margin arcuate, bidentate; anterior margin armed with several denticles; median carina prominent, but smooth and even; terminal segment short, the extremity almost truncate and rather deeply five-lobed, the lobes rounded; the inner margin bidentate. Exposed portions of the abdominal segments sculptured as if covered with rows of scales; fourth segment with a prominent median elevation above. Feet nearly naked; the merus segments slightly carinated above. Length 1·45 in.; length of carapax along the median line ·45, lateral margin ·50, breadth anteriorly ·49. Male and female do not differ.

Several specimens from Egmont Key, west coast of Florida, collected by Col. E. Jewett and William T. Coons. It is specially interesting as the representative of a genus hitherto known only from the Old World.

Æthra scutata, sp. nov.

Carapax transversely and regularly elliptical; margins thin, slightly dentate, the denticles separated by broad and very shallow sinuses; posterior margin nearly straight in the middle; anterior margin straight and parallel to the posterior margin for a short space outside the eyes; front projecting horizontally, its margin forming a semicircle; gastric region elevated, with a broad median depression extending to the front; anterior lobe of branchial region large and prominent; the broad space between the branchial region and the antero-lateral margin concave; summits of the elevations and a space along the posterior border tuberculous, rest of the upper surface smooth; inferior lateral regions slightly convex and smooth. Chelipeds fitting closely to the carapax; the angles projecting into dentate crests; outer and inferior surface of the hand coarsely granulous. Ambulatory legs short, the angles projecting into thin, dentate crests. Sternum and abdomen deeply vermiculated. Length of carapax 1·39 in., breadth 2·23.

A single male of this species, the first of the genus discovered in America, was sent with the *Evibacus* from La Paz by Capt. Pederson. It is at once distinguished from *Æ. scruposa*, Edw., by the much broader and more regularly elliptical carapax.

The genus *Æthra* should evidently be placed near *Crypto-*

podia, as has been done by Stimpson. The gastric region is narrow and projects far forward as in the Maioids. The expansions on the sides of the carapax, which give it a Cancroid form, are thin, and contain none of the internal organs; and their removal would give the carapax very much the form of that of *Cryptopodia*.

XXVII.—*On some new Species of Graptolites.* By Henry Alleyne Nicholson, M.D., D.Sc., M.A., F.G.S.*

[Plate XI.]

Having recently discovered a considerable number of new forms of Graptolites, I purpose in the following communication giving a short diagnosis of the more remarkable ones amongst them, reserving a more detailed description for another occasion. To the twenty-four species which I formerly described from the Skiddaw Slates (Quart. Journ. Geol. Soc. vol. xxiv. p. 125) I have now to add seven new species; and I have also detected *Diplograpsus bicornis*, Hall, and *Phyllograpsus Anna*, Hall, thus raising the total number of Graptolites from this formation to thirty-three. To the rich Graptolitic fauna of the mudstones of the Coniston series I have three new forms to add, making with those I have previously described a total of twenty-seven species (see Quart. Journ. Geol. Soc. vol. xxiv. p. 521). Finally, I have a few new species from the Upper Llandeilo rocks of Dumfriesshire.

Trigonograpsus, gen. nov. Pl. XI. fig. 6.

Gen. char. Frond simple, diprionidian, rapidly tapering towards the base, and having perfectly plain lateral margins without denticles. Cell-partitions alternating with one another, and springing from an undulating or zigzag solid axis. A common canal is probably present, in which case the axis must be excentric; but the evidence on this point is incomplete.

I have been compelled to found this genus for the reception of a single remarkable form which I have recently found in the Skiddaw Slates, and which differs considerably in structure from both *Retiolites* and *Diplograpsus*. As defined by Barrande, *Retiolites* is distinguished by the triangular shape of the frond on transverse section, by the absence of a solid axis, and by a characteristic punctation of the test. The only form to which these characters apply in their entirety is the

* Communicated by the Author, having been read before Section C of the British Association, at Exeter.

familiar *R. Geinitzianus*, Barr.; and it seems safest at present to restrict the genus entirely to this species. *Retiolites venosus*, Hall, and *R. perlatus*, Nich., possess a solid axis, and are likewise distinguished by an extraordinary structure of interlacing reticulated threads, the exact nature of which has yet to be discovered. These will probably have to be placed in a genus by themselves. There remains *R. ensiformis*, Hall, which occurs in the Quebec group of Canada, and which Hall himself hints should probably be removed from *Retiolites*. This last form agrees with the characters of *Trigonograpsus* in having a well-marked solid axis from which the cell-partitions alternately take their origin, in possessing perfectly plain lateral margins, and in the general shape of the frond; and as their geological position is the same, there can be little hesitation about placing the two in the same genus.

Trigonograpsus lanceolatus, Nich. Pl. XI. fig. 6.

Spec. char. Frond flattened, obtusely pointed at the base, and widening out with great rapidity, the breadth just above the base being more than doubled in the space of half an inch. The lateral margins of the frond are bounded by an elevated line, and are perfectly plain, the cellules being in contact throughout their entire length, so that the cell-mouths are all in a line. Along the centre of the frond runs a strong, zigzag, solid axis, from the opposite angles of which there arise in an alternating manner strong cell-partitions, which run nearly to the margin, and form with the axis as high an angle as 75°. The test shows no traces of a punctated or reticulated structure.

This form is certainly in many respects allied to *Trigonograpsus* (*Retiolites*) *ensiformis*, Hall; but it is separated by very well-marked characters, of which the more important are the nearly straight axis in the latter, and the much greater obliquity of the cellules, which form with the axis an angle of not more than 50°. In our species, on the other hand, the axis is strongly bent from side to side, and the cellules form with it an angle of about 75°.

Loc. Upper beds of the Skiddaw Slates, Ellergill, near Milburn.

Dichograpsus fragilis, Nich. Pl. XI. figs. 1–3.

Spec. char. Frond multibrachiate, consisting of several (probably eight) simple, monoprionidian stipes, arising from a median non-celluliferous funicle. Centrally is placed a small pointed radicle, from which proceed the two primary divisions of the funicle. These subdivide, at a distance of about half a

line from the radicle, into two secondary branches, of which one is directed upwards and one downwards. Of these the superior branch appears to give off no tertiary offsets, being directly prolonged into the celluliferous stipe. The inferior branch, on the other hand, gives off two tertiary offsets on the same side, the extremities of the three divisions thus produced becoming celluliferous upon one side. The stipes are extremely slender; the cellules are about twenty in the space of an inch; the cell-mouths are at right angles to the back of the stipe, and the denticles are simply angular, and not mucronate.

This pretty little species is distinguished from all the other members of the genus by its very minute size, by its mode of branching, and by the extreme tenuity of the divisions of the funicle and of the celluliferous stipes.

Loc. Upper beds of the Skiddaw Slates, Thornship Beck, near Shap.

Dichograpsus (?) *annulatus*, Nich. Pl. XI. figs. 4 & 5.

Spec. char. Frond compound, branching and rebranching. Base unknown. Branches coming off from one another more or less nearly at right angles, often attaining a length of from four to five inches, and preserving a uniform width of about a line. Cellules from seventy to ninety in the space of an inch. The face of every one of the stipes is crossed by a number of transverse, sometimes slightly wavy, ridges, amounting to the above number in the inch; but the state of preservation of the specimens is such that it is impossible to determine whether these are the cell-partitions or are the mouths of the cellules shown in a scalariform view. In the former case the direction of the cellules would be nearly transverse to that of the stipes. The margins of the stipes, however, are quite plain and exhibit no denticles; so that the latter view would appear to be the correct one.

This singular form is recognizable, even in small fragments, by the presence of the above-named transverse ridges, which give the stipes somewhat of the aspect of a ringed worm. Whichever view be adopted of the nature of these ridges, they unquestionably mark the position of the cellules, which are thus seen to reach the extraordinary number of not far from 100 in the space of an inch. The central portion of the frond is not shown in any of my specimens (the best of which was discovered by Mr. Christopherson, of Keswick); and it is therefore impossible to fix finally the generic position of the species. Its mode of branching, however, corresponds closely with that of *Dichograpsus*; and as this genus has its home in

the Skiddaw Slates, the position of our form is most probably here.

Loc. Rare in the Skiddaw Slates of Barrow, near Braithwaite, and of Wath Brow, near Keswick.

Diplograpsus Hopkinsoni, Nich. Pl. XI. fig. 7.

Spec. char. Frond diprionidian, from half to three-quarters of an inch in length exclusive of the distal prolongation of the solid axis, and having a breadth of from one to one and a half line. Base ornamented with a minute triangular radicle, flanked by two long, curved, setiform processes, many times greater in length than the central mucro. Cellules about twenty-four in the space of an inch, obtusely triangular in shape, terminating in long drawn-out tips or denticles, which are obtusely pointed and are usually slightly bent downwards, but which do not terminate in distinct spines.

The specimens of this form which had previously come under my notice were confounded by me with *D. mucronatus*, Hall, to which they bore, in the shape of the cellules, a considerable resemblance. Having now, however, discovered more perfect specimens, in which the base is exhibited, I have been led to alter this opinion. *D. Hopkinsoni* is altogether larger and broader than *D. mucronatus*, the cellules are larger and fewer to the inch, whilst the denticles are turned downwards, and do not terminate in spines. Finally, *D. mucronatus* does not possess the long basal spines which are so characteristic of *D. Hopkinsoni*. These spines are sometimes of great length (a quarter of an inch in one specimen), and in all their characters they resemble those of *Climacograpsus antennarius*, Hall, which is a characteristic species in the Skiddaw Slates. I have named this form after Mr. John Hopkinson, who has recently written an excellent paper on the subject of Graptolites.

Loc. Skiddaw Slates of Outerside, near Keswick.

Diplograpsus armatus, Nich. Pl. XI. fig. 8.

Spec. char. Frond diprionidian, varying in length from four lines to more than one inch, exclusive of the distal prolongation of the axis. Breadth, exclusive of the spines, from one to one and a half line. Base obtusely pointed, with a single short radicle. Cellules extremely remote, not exceeding twelve in the space of an inch, and having their apices furnished with broad, tapering, slightly deflexed spines, which attain the comparatively enormous length of from one to two lines; so that the breadth of a full-grown specimen, including the spines, may be as much as five lines.

All the specimens which I have of this species are derived from the upper beds of the Skiddaw Slates, and are both poorly preserved and a good deal distorted by cleavage. The great remoteness of the cellules, however, and the extraordinary length of their spiny appendages are characters which distinguish this from all other forms.

Loc. Upper beds of the Skiddaw Slates, Thornship Beck, near Shap.

Diplograpsus Hughesi, Nich. Pl. XI. figs. 9 & 10.

Spec. char. Frond diprionidian, about one quarter of an inch in length, and one-sixteenth of an inch in width in the fully developed portion. Base obtusely pointed, apparently without any proximal extension of the solid axis. Frond forming a cylindrical tube, which is divided into two vertical compartments by a longitudinal septum. This septum, in all the *Diplograpsi* with which I am acquainted, is perfectly straight or is very slightly undulated; and its lateral margins appear on the exterior of the test as very slightly wavy or straight lines between the rows of cellules. In the present species, however, the septum must be strongly and sharply bent first to one side and then to the other, since the impressed line on the exterior (which may conveniently be called the "suture") is regularly and strongly bent from side to side so as to be almost zigzag. The common canal is excessively narrow. The base of each cellule is applied to a concavity of the undulating septum, so that a regular alternation is maintained on the two sides of the frond. The cellules are about thirty in the space of an inch, overlapping one another not at all or for an extremely short distance, curved, nearly vertical (or parallel to the axis of the frond), their outer margins strongly convex; the cell-mouths horizontal (or at right angles to the axis of the frond). The test is perfectly smooth.

This extraordinary species reminds us of *D. tamariscus*, Nich., in the characters of the curved, cup-shaped, vertical cellules, with their horizontal cell-mouths and extremely narrow common canal. It is easily distinguished, however, by the undulated (not straight) suture, and by the constant absence of the beautiful transverse striæ which are so characteristic of all examples of *D. tamariscus* which are preserved in relief. I have named the species after my friend Mr. Hughes, of the Geological Survey.

Loc. Graptolitic mudstones of the Coniston series, Skelgill Beck, near Ambleside. (Beautifully preserved in relief.)

Diplograpsus sinuatus, Nich. Pl. XI. fig. 11.

Spec. char. Frond diprionidian, from four to five lines in

length, and one line in breadth in the fully developed portion. Base pointed, and furnished with a long straight radicle. Cellules from thirty-six to forty-five in the space of an inch, forming an angle of about 40° with the axis, and overlapping one another for more than two-thirds of their entire length. In shape the cellules are somewhat curved, wide at the base, contracted in the middle of their length, and expanding into rounded knobs towards the cell-mouths.

This species is only known to me by some two or three specimens, in a state of high relief, from the mudstones of the Coniston series. The characteristic of the species is the peculiar sinuous outline of the cellules, produced by the undulating cell-partitions.

Loc. Graptolitic mudstones of the Coniston series, Skelgill Beck, near Ambleside.

Diplograpsus bimucronatus, Nich. Pl. XI. figs. 12 & 12′.

Spec. char. Frond diprionidian, from one to two inches in length, and attaining in the fully-grown portion of large specimens a width of over two lines, exclusive of the spines from the cell-mouths. Base obtusely pointed. Cellules from twenty-eight to thirty in the space of an inch, broad at the base and gradually tapering towards the cell-mouths, so as to form long extended denticles, the upper margins of which are nearly straight and are at right angles to the axis, whilst the inferior margins are curved and form an angle of about 45° with the axis. The extremity of each denticle is furnished with *two* long flexible spines, which are usually bent downwards, and sometimes attain the extraordinary length of more than one line and a half; so that the breadth of the entire frond, including the spines, may be as much as a quarter of an inch. The spines increase regularly in length as the distal extremity of the frond is approached.

In the general shape of the cellules, *D. bimucronatus* closely resembles *D. mucronatus*, Hall, from which it is distinguished by the much greater size of the frond and by the possession of two spines proceeding from the extremity of each denticle, the latter species possessing but one spine, and that a smaller one, to each cellule. From *D. quadrimucronatus*, Hall, in which each cellule has two spines, our species is readily separated by the characters of the cellules.

Loc. Not uncommon in a single bed of anthracitic shale, Glenkiln Burn, Dumfriesshire.

Diplograpsus insectiformis, Nich. Pl. XI. fig. 13.

Spec. char. Frond diprionidian, not exceeding two and a half

to three lines in length, averaging two lines, elongate-ovate in shape, tapering towards both extremities, the width in the middle being nearly one line, exclusive of the spines. Base obtusely pointed, with a minute, sometimes double, radicle. Axis apparently not prolonged beyond the distal extremity of the frond. Cellules forty-two in the space of an inch, overlapping one another for about half their entire length, their lower margins straight, inclined to the axis at an angle of not more than about 25°, and having the cell-mouths nearly rectangular to the axis of the frond. Denticles pointed and furnished with rigid straight spines, which are usually directed slightly upwards.

Out of about thirty individuals of this gregarious little species, all upon the same piece of shale, no important departures from the above characters are observable. The small size and ovate shape of the frond, the low angle which the cellules form with the axis, the acutely pointed denticles, and the presence of straight spines at the cell-mouths sufficiently distinguish the species.

Loc. Upper Llandeilo rocks of Dobb's Linn, near Moffat.

Diplograpsus vesiculosus, Nich. Pl. XI. figs. 14 & 15.

Spec. char. Frond diprionidian, the celluliferous portion attaining, in fully grown specimens, a length of from one to two inches, and a breadth of from one-eighth to one-sixth of an inch. The celluliferous margins of the frond are almost parallel till close upon the base, when they converge to form a short obtusely pointed basal process, resembling that of *D. palmeus*, Barr. In the centre of the frond, in place of the ordinary solid axis of the *Diplograpsi*, is a tubular body, bordered laterally by filiform margins. Whether a true solid axis, in the form of a cylindrical filament, is also present, cannot be determined. The axial tube is narrow proximally, but widens out distally till a width of nearly one line may be reached, and on passing finally beyond the celluliferous portion of the frond it is directly prolonged into a long, fusiform, ovate or cylindrical, vesicular dilatation, which is bordered by strong filiform margins. This terminal vesicle, at first narrow, attains a width of from one-tenth to one-fifth of an inch, and then contracts to an acuminate apex. The cellules are in contact throughout their entire length, from twenty-five to thirty in the space of an inch, inclined to the axial tube at an extremely low angle (about 25°). The cell-mouths are nearly parallel to the median line of the frond, and are gently rounded and convex, not forming distinct denticles; so that the celluliferous margin of the frond appears simply as an undulating line.

The external portions of the test appear to have been the strongest portions of the polypary, and are always more strongly defined than the inner.

The name which I have adopted for this extraordinary species appears to be somewhat unfortunate, since it seems to have given rise to the opinion that the presence of a terminal vesicle is the most important or the sole distinguishing character of the species. This distal vesicle is sometimes seen, to a limited extent, in *D. pristis*, His., and in *D. palmeus*, Barr.; and in this respect our species is only remarkable in *always* having the vesicle, and in its very large size. *D. vesiculosus*, however, is totally and entirely distinct from any other *Diplograpsus* known to me, and its characters are recognizable even in very small fragments. It is completely separated from all other forms by the following characters:—1, the parallelism of the celluliferous margins of the frond; 2, the obtusely pointed, triangular basal process; 3, the contiguity of the cellules throughout their entire length; 4, the absence of distinct denticles; 5, the exceedingly small angle which the cellules form with the central line of the frond; 6, the possession of a median axial tube of considerable width, in the place of, or in addition to, a true solid axis; 7, the possession of a terminal dilatation or vesicle, formed by an expansion of the axial tube.

This combination of characters cannot be predicated of any other known form, and is sufficient to place the validity of the species beyond reasonable doubt.

Loc. Upper Llandeilo rocks of Dobb's Linn and Frenchland Burn, near Moffat. Rare in the mudstones of the Coniston series, Skelgill Beck, near Ambleside.

Climacograpsus innotatus, Nich. Pl. XI. figs. 16 & 17.

Spec. char. Frond diprionidian, from three to five lines in length, and little more than half a line in width in its fully developed portion. Base pointed, with a minute radicle. Axis prolonged beyond the distal extremity of the frond. Cell-apertures forming rounded notches, sunk below the general margins of the frond, and from twenty-eight to thirty-five in the space of an inch. The projecting portions of the frond between the notches formed by the cell-mouths are somewhat quadrangular, with the angles rounded off; and from the inferior angle of each arises a short stout spine, which is directed horizontally over the mouth of the cellule below.

This species agrees with *Climacograpsus typicalis*, Hall, in the possession of spines; but it is altogether a much smaller

and narrower form, and differs still further in the characters of the cellules.

Loc. Upper Llandeilo rocks of Dobb's Linn, near Moffat.

Climacograpsus tuberculatus, Nich. Pl. XI. fig. 18.

Spec. char. Frond diprionidian, from half to over three-quarters of an inch in length, and of a breadth of about one line in the fully developed portion. The base is pointed, and is provided with three strong tapering spines or mucronate processes, of which the central one is the smallest and constitutes the true radicle, whilst the two lateral ones are nearly rectangular to the axis, and are slightly curved towards their extremities. The cellules are about thirty in the space of an inch, excavated in the substance of the frond, and appearing in a scalariform specimen as linear or elliptical apertures extending across the stipe. Between the rows of cellules on the two lateral surfaces of the frond, the test is furnished with a linear series of tubercles or outward processes of the periderm, which are sometimes square, sometimes more or less triangular in shape. One of these processes arises from, or in the immediate vicinity of, the lateral angle of each cell-aperture.

This form is allied to *C. bicornis*, Hall, but is clearly separated by the lateral tubercles, as well as by the nearly horizontal position of the two lateral spines at the base.

Loc. Rare in the Upper Llandeilo rocks of Dobb's Linn, near Moffat.

Graptolites argenteus, Nich. Pl. XI. fig. 19.

Spec. char. Stipe simple, monoprionidian, commencing proximally in a delicate curved base, and then proceeding in a nearly straight line. Base extremely slender, the cellules having here very much the character of those of *G. Nilssoni*, except that their apices are reflexed. They are long, narrow, and triangular, about eighteen in the space of an inch, the entire length of this portion of the stipe being about four-tenths of an inch. From this point the stipe gradually widens, until a breadth of as much as one line may be reached; but this does not appear to be exceeded. The cellules in the adult portion of the stipe are very closely set (from forty to forty-five in the space of an inch), long, narrow, overlapping one another for more than two-thirds of their entire length, and having their apices reflexed. The basal portion of the cellules is a little wider than the mouth; and the length of a full-grown cellule is about a line, the width not exceeding one-fortieth of an inch. In the distal portion of the stipe the apices of the cellules are

not turned down at all. The common canal is extremely narrow; and the cellules form with it an angle of about 35°.

This beautiful species presents a superficial resemblance to *G. priodon*, Bronn. It is distinguished, however, by the slender, linear, sharply curved base, the cellules of which resemble those of *G. Nilssoni*, by the much greater number of cellules to the inch (those of *G. priodon* not exceeding twenty-five, whilst those of *G. argenteus* are from forty to forty-five), by the great comparative length and nearly uniform width of the cellules, and by the great rapidity with which the stipe attains its full dimensions. Further, it is only in the lower portion of the adult part of the stipe that the cellules resemble those of *G. priodon*, since it is only here that they are reflexed at their extremities.

Loc. Abundant, and beautifully preserved in relief, in a single thin band in the mudstones of the Coniston series, Skelgill Beck, near Ambleside.

Didymograpsus affinis, Nich. Pl. XI. fig. 20.

Spec. char. Frond consisting of two extremely slender stipes, each from half to three-quarters of an inch in length, diverging from an initial point, which is provided with a long and pointed radicle of about one line in length. The stipes are very narrow, having a uniform width of from one-fiftieth to one-fortieth of an inch. The cellules are on the opposite side of the frond to the radicle; and the "angle of divergence"* varies from 90° to 150°, the stipes being straight or gently

* In the specific determination of any *Didymograpsus*, one of the most important points in the diagnosis is found in the "angle of divergence" of the two stipes which compose the frond. It is obvious, however, that the two stipes, diverging from a single point, form *two* angles; and it is equally obvious that this character is absolutely valueless unless the *same* angle be always chosen for purposes of comparison. The ordinary practice, in the case of the *Didymograpsi*, has been to take the *smallest* angle, and to call that the "angle of divergence," or, in cases where the two angles were equal, to take the angle formed by the two stipes on the side on which the cellules were placed. Now, in neither of these cases is it really the same angle which is compared in different species; or, at any rate, it is not necessarily or invariably the same. The proper method of comparison is to take the angle formed by the stipes *on the opposite side of the frond to the radicle*, and to consider that as the "angle of divergence." In this way a constant standard of comparison is obtained, since the radicle always marks the organic base of the frond. A neglect of this obvious point has led to extraordinary confusion amongst the British members of this genus, as I shall point out upon some future occasion. The angle formed by the stipes *upon the same side as the radicle* may conveniently be called the "radicular angle;" and the cellules, in different sections of the *Didymograpsi*, are found to occupy the sides of the angle of divergence or of the radicular angle.

curved. The cellules are about eighteen in the space of an inch, and are indistinguishable in all their characters from those of *G. Nilssoni*, Barr. They are long, narrow, and so arranged that they do not overlap one another at all; the outer cell-walls being inclined to the axis at an angle of not more than 15° to 20°, and being three to four times as long as the cell-mouths, the latter forming short transverse apertures at right angles to the axis.

This pretty little species is readily separated from all allied forms (such as *D. nitidus*, Hall, and *D. serratulus*, Hall) by the remote free cellules, which do not overlap one another, by the general shape of the frond, and by the small length and great tenuity of the stipes.

Loc. Lower beds of the Skiddaw Slates, Barff, near Keswick. Upper beds of the Skiddaw Slates, Ellergill, near Milburn; and Eggbeck, near Pooley.

Didymograpsus fasciculatus, Nich. Pl. XI. figs. 21 & 22.

Spec. char. Frond consisting of two simple stipes arising from a short obtuse radicle. The stipes are at first directed horizontally outwards, but are immediately bent downwards towards the radicle, again curving horizontally outwards. The cellules occupy the concave face of each stipe, forming thus the angle of divergence; but, owing to the curvature of the stipes, the amount of this angle can hardly be stated. Each stipe is extremely narrow at first, but gradually widens out till a breadth of nearly one twenty-fourth of an inch may be reached. The common canal is very narrow, but is wider than the cellules. The cellules are excessively long and narrow, curved, following the curvature of the stipe, the cell-mouths being at right angles to the axis of the cellules. The cell-mouths are not more than about twenty-four in the space of an inch in the adult portion of the stipe, and the cellules overlap one another for fully two-thirds of their entire length. An individual cellule, when fully grown, may have the extraordinary length of more than two lines, with a uniform breadth of not more than one-hundredth of an inch. Owing to the great length and narrowness of the cellules, and owing to their inclination being so small that they are nearly parallel to the back of the stipe, the cellules in the distal portion of the stipe appear to form a bundle of long narrow tubes. In consequence of this, a line drawn at right angles to the distal portion of the stipe would exhibit a section of three, or even four, cellules.

This species cannot be confounded with any other, being distinguished by the curiously curved stipes with the cellules on their concave aspect, the latter being nearly parallel to the

back of the stipe, and attaining an extraordinary length as compared with their breadth.

Loc. Rare in the upper beds of the Skiddaw Slates, Ellergill, near Milburn, Thornship Beck, near Shap, and Eggbeck, near Pooley.

EXPLANATION OF PLATE XI.

Fig. 1. Specimen of *Dichograpsus fragilis*, n. sp., nat. size.
Fig. 2. The same, enlarged.
Fig. 3. Portion of the same, enlarged still further, to show the cellules.
Fig. 4. Portion of *Dichograpsus annulatus*, n. sp., showing the transverse ridges.
Fig. 5. Portion of the same, enlarged.
Fig. 6. *Trigonograpsus lanceolatus*, n. sp., enlarged.
Fig. 7. *Diplograpsus Hopkinsoni*, n. sp., enlarged.
Fig. 8. *Diplograpsus armatus*, n. sp., enlarged.
Fig. 9. Portion of *Diplograpsus Hughesi*, n. sp., greatly enlarged, to show the cellules.
Fig. 10. *Diplograpsus Hughesi*, enlarged.
Fig. 11. *Diplograpsus sinuatus*, n. sp., enlarged.
Fig. 12. *Diplograpsus bimucronatus*, n. sp., enlarged.
Fig. 12'. Fragment of another specimen of *D. bimucronatus*, enlarged, to show the cellules.
Fig. 13. *Diplograpsus insectiformis*, n. sp., enlarged.
Fig. 14. Upper portion of *Diplograpsus vesiculosus*, n. sp., slightly enlarged. (The serration of the margin in this figure is too pronounced.)
Fig. 15. Portion of *D. vesiculosus*, enlarged, showing the cellules, axial tube, and base.
Fig. 16. *Climacograpsus innotatus*, n. sp., enlarged.
Fig. 17. Portion of *C. innotatus*, greatly enlarged, to show the cellules.
Fig. 18. *Climacograpsus tuberculatus*, n. sp., enlarged.
Fig. 19. *Graptolites argenteus*, n. sp., enlarged.
Fig. 20. *Didymograpsus affinis*, n. sp., enlarged.
Fig. 21. *Didymograpsus fasciculatus*, n. sp., enlarged.
Fig. 22. Portion of *D. fasciculatus*, still further enlarged, to show the cellules.

XXVIII.—*Descriptions of four new Species of Diurnal Lepidoptera of the Genus* Thyca. By A. G. Butler, F.L.S. &c.

Genus Thyca, Wallengren.

1. *Thyca Ithiela*, sp. nov.

♂. Alæ supra nigræ: anticæ velut in *T. Horsfieldii* cinereo plagatæ et maculatæ: posticæ macula magna subcostali subovali aureoflava apud basin posita, maculis quinque discalibus, serie angulari velut in *T. Horsfieldii* positis, maculisque quinque cinerascentibus semicircularibus submarginalibus; area abdominali cinerea, haud flavo maculata: corpus nigro-cinereum, antennis nigris.

Alæ subtus fere velut in *T. Horsfieldii*, maculis autem posticarum

multo minoribus et latius separatis: corpus cinereum, abdomine albicante; antennis nigris, cinereo-squamosis.

Exp. alar. unc. 3, lin. 8½.

Hab. Penang. ♂. Presented 1860, by the Hon. East-India Company.

♂. Obtained 1843, from Mr. L. James. B.M.

This handsome species is larger than the nearly allied *T. Horsfieldii*, and may be distinguished from it at a glance by the smaller spots on both surfaces of the posterior wings, and the absence of any yellow patch upon the abdominal margin.

2. *Thyca fragalactea*, sp. nov.

♂. Alæ supra simillimæ iis *T. Argenthonæ*, area autem apicali anticarum et marginali posticarum angustius nigrescente.

Alæ subtus simillimæ iis *T. Argenthonæ*: anticæ autem maculis apicalibus albis magis regularibus, margineque magis regulari et angustiore, maculam albam statim pone cellam haud exhibente: posticæ area basali flava multo profundiore, nec ad basin obscurata; macula coccinea discocellulari a maculis submarginalibus late separata et aream apicalem intus limitante; maculis submarginalibus minus albo cinctis: corpus album.

Exp. alar. unc. 3, lin. 1.

Hab. North coast of Australia. Presented 1846 and 1853, by the Earl of Derby, and collected by Mr. Macgillivray. B.M.

Closely allied to *T. Argenthona*, but quite distinct.

3. *Thyca Lucerna*, sp. nov.

♂. Alæ supra simillimæ iis *T. Henningiæ*: anticæ fascia obliqua submedia multo angustiore et cinerascente, striolis subapicalibus distinctioribus: posticæ fasciola cinerea obsoleta; plaga flava duplo majore; corpus nigro-cinereum.

Alæ subtus iis *T. Henningiæ* persimiles fascia autem media anticarum angustiore, maculisque quinque subapicalibus albis; fasciæ marginali posticarum paulo latiore venisque angustius nigro marginatis: corpus thorace fusco-cinereo, abdomine albo.

Exp. alar. unc. 3, lin. 3.

♀. Alæ supra nigro-fuscæ: anticæ fere velut in *T. Pasithoë* ♀ maculatæ, fascia autem media albidiore et magis integra: posticæ plagis tribus, maculisque quatuor squamosis a margine abdominali ad apicem serie decrescente arcuata currentibus; squamis nonnullis in cella discoidali vena mediana ab his separatis: corpus thorace nigro; abdomine albo, stria dorsali cinerea; antennis nigris.

Alæ subtus velut in mari at pallidiores et maculis sex anticis ... alibus albis.

... unc. 3, lin. 2.

Hab. ♂ ♀. Philippines. Obtained 1867, through Mr. Higgins. B.M.

Allied to *T. Henningia*, and intermediate in character between it and *T. Pasithoë.*

4. *Thyca ochreopicta*, sp. nov.

♂. Alæ supra nigro-fuscæ: anticæ fere velut in *T. Ægialea*, albido fasciatæ et cinereo punctatæ: posticæ iis *T. Henningiæ* simillimæ; plaga autem abdominali breviore et ochracea: corpus nigro-cinereum.

Alæ subtus iis *T. Henningiæ* persimiles: anticæ autem fascia alba, magis obliqua, striolis quinque subapicalibus: posticæ ochraceo-flavæ, striola basali coccinea angustiore: corpus thorace nigro, abdomine albido.

Exp. alar. unc. 2, lin. 9–unc. 3.

Hab. ♂. Philippines. Obtained 1866; collected by Herr G. Semper. B.M.

♂. Obtained 1867, through Mr. Higgins.

This species, though very closely allied to *T. Henningia*, may be readily distinguished by its more arched anterior wings, and the more ochraceous colouring of the yellow in the posterior wings, with several other differences. It may be regarded as intermediate between *T. Henningia* and *T. Ægialea.*

XXIX.—*The Myology of* Cyclothurus didactylus. By John Charles Galton, M.A., F.L.S., Lecturer on Comparative Anatomy at Charing Cross Hospital*.

[Plate VIII.]

Through the kindness of Prof. Flower, F.R.S., Conservator of the Museum of the Royal College of Surgeons, I have been enabled to examine the muscles of a specimen of the Two-toed Anteater (*Cyclothurus didactylus*, Lesson †). The animal was

* Communicated by the Author, having been read at the Meeting of the British Association for the Advancement of Science, at Exeter, August 24, 1869.

† See 'Revision of the Genera and Species of Entomophagous Edentata,' by Dr. J. E. Gray, F.R.S. (Proc. Zool. Soc. April 1865, p. 385 and pl. 19.

No mention is made of this species of Anteater either in the French edition (2 vols. Paris, 1801) of Don Felix d'Azara's Essays on the Natural History of the Quadrupeds of Paraguay, or in Dr. Rengger's 'Naturgeschichte der Säugethiere von Paraguay,' Basel, 1830. In the first volume (the only one ever published), however, of an English translation from the original Spanish of the former author, by Mr. W. Perceval Hunter, F.G.S. (Edin. 1838), we are informed (p. 163) that "Buffon describes a third species of Anteater;" and the Don proceeds, somewhat scoffingly, to question the correctness of the observations of this unfortunate butt of natu-

a female, fairly developed, and measured from the tip of the snout to the extremity of the tail 15 inches, and from the tip of the latter to the anus 8¾ inches.

This is not the first time that the muscles of this species of Anteater have been the subject of description either by pen or pencil, seeing that Meckel, at the beginning of the present century, published a paper on its anatomy in the 'Archiv' which bear his name*, and Cuvier devoted two plates of his splendid Atlas to the illustration of its myology†.

Since, however, the descriptions of the former author are somewhat lacking in completeness and fulness in certain points, and since the figures drawn by the latter, though from an artistic point of view faultless, are, for the stern needs of the dissector, "un faible secours," as remarked by M. Pouchet, it is hoped that the following notes will fill up any gaps which may still exist in the knowledge to which these great anatomists have so largely contributed‡.

Panniculus carnosus. This muscle is most developed in the abdominal region and flanks. The "portion ventrale" of Cuvier is, on either side of the middle line of the abdomen, fused with the aponeurosis of the external oblique; while dorsally it is continued into fascia covering the the intercostal muscles and those of the back.

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ralists, and thus concludes, after the fashion of a counsel on a losing side:—"Finally, I leave it to time to prove or disprove my conjecture." Time has disproved his conjecture; and Buffon, for once in a way, is right.

The translator, in some "Additional Notes" (p. 169), quotes from the 'Penny Cyclopædia' (vol. ii. pp. 63–66) a description of the habits of the Anteater in question, which was taken from Von Sack's 'Narrative of a Voyage to Surinam'—a work, as Mr. Hunter truly observes, "rarely met with."

I extract from the preface to Mr. Hunter's translation the Spanish titles of Azara's works, which were published in five octavo volumes:—

1. "Apuntamientos para la Historia natural de los Quadrupedos del Paraguay y Rio de la Plata, escritos por Don Felix de Azara, en dos tomos, en la imprenta de la viuda de Ibarra, Madrid."

2. "Apuntamientos para la Historia natural de los paxaros del Paraguay y Rio de la Plata, escritos por Don Felix de Azara, en tres tomos, Madrid, 1802."

* "Anatomie des zweizehigen Ameisenfresser," Archiv für die Physiologie, V^er^ Bd. Halle & Berlin, 1819.

† Anatomie Comparée, recueil de planches de myologie dessinées par Georges Cuvier ou exécutées sous ses yeux par M. Laurillard. Fol. Paris, 1855, pls. 257 & 258.

‡ I should here state that Prof. Humphry had completed the dissection of a Two-toed Anteater before my labours had begun; but, as he intends reserving his notes for the next number of the 'Journal of Anatomy and Physiology,' he has, with great kindness and liberality, made no objection to the prior publication of observations which are, in point of time, of later date than his own.

The outermost fibres of the ventral portion pass over the outer aspect of the thigh, and are lost in the fascia covering the outer side of the thigh and leg of either side, acting thus as a tensor fasciæ femoris externus (Cuvier, pl. 257. fig. 1, and pl. 258). This arrangement keeps the thigh semiflexed upon the abdomen.

The uppermost fibres, "portion latérale" (Cuvier, pl. 257. fig. 1, and pl. 258), split near their termination into two flat bundles, the innermost of which appears to become blended with the inferior surface of those fibres of the pectoralis major which take origin from the costal cartilages, while a few fibres seem to be prolonged as far as the first or second rib. The outermost bundle joins a small slip given off from that portion of the latissimus dorsi (namely, from its innermost edge) which furnishes the dorso-épitrochlien, which slip is continued into the inferior surface of the terminal tendon of the pectoralis major.

The portion answering to the platysma myoides is but poorly developed.

There is no trace of a musculus sternalis.

The rectus abdominis is very well developed. As in *Dasypus*, it broadens out on reaching the thorax, over which it was prolonged, terminating at ribs 2 to 6, inclusive, by digitations corresponding to the point of origin of the obliquus externus from these ribs. The highest fibres, which are continuous with the inner edge of the muscle, are inserted into the second rib by an extremely delicate tendon, easily overlooked. There was no complete sheath for the muscle. The superficial surface was covered by the aponeurosis of the internal oblique; while the deep surface was, on its outer half, invested with the fibres of the transversalis, the inner half being covered by the aponeurosis of the same muscle, which probably, along the inner edge of the rectus, fused with that of the internal oblique muscle. The outer edge of the rectus was not bounded by any sheath.

This muscle, according to Meckel (Archiv, p. 40) has three "inscriptiones tendineæ" (Sehnenstreifen), the middle one being the most conspicuous. Its thoracic attachment, according to the same authority, is to the eight uppermost costal cartilages. The tendinous bands were by no means clearly marked in the specimen which I examined.

There was a well-developed rectus thoracicus lateralis. It arose from about the seventh to the eleventh ribs inclusive, passed over the boundary-line of the insertions of the serratus magnus and the thoracic origin of the obliquus externus, and was inserted into the second rib, at about the junction of the costal with the sternal portion.

Since this muscle coexists with an upward prolongation of the rectus abdominis, it can scarcely be regarded as a "lateralized" slip of the rectus, as suggested by Prof. Macalister*. It is, moreover, completely separated from the rectus by a muscular stratum composed of the thoracic fibres of origin of the obliquus externus. Cuvier figures the muscle very clearly (pl. 257. fig. 2), but terms it "scalène, portion extérieure ou inférieure." In his plate of the myology of *Myrmecophaga tamandua* (pl. 262), it is represented as passing over the serratus magnus. I am inclined to regard this muscle, as evidently did Cuvier, as a downward detachment from the scalenus.

Mr. Wood describes a similar muscle as occurring in man, under the name of "supracostal" (Proc. Roy. Soc. June 1865, p. 3, and May 1867, p. 523). A like muscle, too, is recorded and figured as a human abnormality in Virchow's 'Archiv,' Nov. 1867 (Taf. 6. fig. 1).

The rhomboidei are fused together into one muscle. They arise from the upper third of the dorsal vertebral region, and are inserted along the whole of the superior (or posterior) costa of the scapula; covered by the trapezius. I did not find any occipito-scapular slip.

The trapezius arose from the occiput, from the spines of the cervical vertebræ, and from the vertebral spines in the upper third of the dorsal region. It was inserted along the posterior (superior) edge of the spine of the scapula, and into the distal fourth of the clavicle. Meckel notices (Archiv, p. 38) the clavicular insertion.

The acromio-basilar was not present.

The serratus magnus was well developed. It seemed to be made up of three factors:—

1. The highest, evidently corresponding to the levator scapulæ, arose from the two or three lower cervical vertebræ, and was inserted into the superior angle of the scapula and, for some little distance, along the superior costa of the bone, being overlapped by the highest fibres of origin of the rhomboideus.

2. The smallest factor, inserted into the inner face of the scapula, internal to the division just described, arose from the first rib, just external to the insertion of the scalenus anticus, with the outermost fibres of which muscle it appears to be in intimate connexion.

3. The lowest, corresponding to the serratus magnus of anthropotomy, arose from the second to the seventh ribs, inclusive, external to the rectus abdominis, being overlapped at its origin by the outer border of this muscle. A few fibres, too,

* "On the Myology of *Bradypus tridactylus*," Ann. & Mag. Nat. Hist. July 1869, p. 55.

arose from the first rib, in a space included between the insertion of the scalenus and the rectus lateralis. The insertion was at the inferior angle of the scapula and part of the axillary costa of this bone.

There was no trace of an omohyoid on either side. This muscle seems to be absent in all the Edentata. Prof. Hyrtl describes it as wanting in *Chlamydophorus**.

The levator claviculæ was absent.

The sterno-cleido-mastoid arose from the mastoidal and adjacent portion of the occipital region of the skull, the sternal factor being most anterior. The cleido-mastoid portion had a broad fleshy insertion into the middle third of the clavicle, the outermost fibres being in a line with the innermost fibres of origin of the deltoid. The sterno-mastoid had a tendinous insertion at the junction of the clavicle with the sternum (into the "omo-sternal" element of Parker), but had no prolongation over the pectoralis major, being, in fact, completely covered by the upper edge of the muscle.

The subclavius is absent, as it is in *M. jubata* and *tamandua.* This muscle, according to Prof. Hyrtl, is "egregie evolutus" in the Chlamydophore.

The deltoid was very well developed, and appeared to be made up of three factors:—

1. Clavicular, the largest, arose from the scapular half of the inferior edge of the clavicle and from the acromion, and was inserted into the upper part of the deltoid tuberosity above the origin of the brachialis anticus.

2. Acromial, arose from the upper half of the spine of the scapula, and was inserted into the humerus just posterior to the origin of the supinator longus.

3. Spinous, took origin from the middle third of the spine of the scapula, and was inserted beneath the preceding division of the muscle.

According to Hyrtl, the deltoid has no clavicular portion in *Chlamydophorus.*

There was nothing worthy of note in the supraspinatus.

The infraspinatus and teres minor were fused together.

The subscapularis had the usual point of attachment.

The teres major was enormously developed. The bulk of the muscle arose from the lower half of the axillary costa of the scapula, but was joined by a thin stratum of muscular fibres which took origin from the whole of that portion of the spine of the scapula which lies posterior to the origin of the

* "*Chlamydophori truncati* cum *Dasypode gymnuro* comparatum examen anatomicum" (Denkschrift. der k. Akad. der Wissenschaft. in Wien, ix. Band, 1855).

second division of the deltoid, a pouch being thus formed the concavity of which looked upward. The muscle was inserted along the whole length of the inner edge of the shaft of the humerus, the lowest fibres terminating at a ridge situated above the inner condyle. Cuvier evidently regarded this muscle as a portion of the triceps. Those fibres which arose from the scapular spine he held to be an accessory factor ("extenseur venant de l'épine de l'omoplate," pl. 257. fig. 1). If the whole of the muscle is not to be regarded as the teres major, that portion, at any rate, which arises from the costa of the scapula must be considered as such, while those fibres which arise from the scapular spine may be regarded as a portion of the triceps which has fallen short of its insertion.

No part of this enormous muscle reached the olecranon, no fibres, in fact, passing below the foramen in the humerus which transmits the median vessels and nerve.

Cuvier represents the teres major in the Two-toed Anteater as a small muscle which becomes fused with the latissimus dorsi before insertion (pl. 257. fig. 3).

This muscle is stated by Meckel (Archiv, p. 42) to be "sehr stark." Beside a humeral attachment similar to that just described by me, a portion of the muscle is said to pass to the olecranon, and thus to be adjutant to the extensor of the fore-arm, as a factor of which muscle it is finally regarded by Meckel.

The muscle which I have termed teres major was supplied, on the inner aspect of the arm, behind the tendon of the latissimus dorsi, by a nerve (subscapular?) given off from the lower of the two factors of the axillary nerve.

Latissimus dorsi. A few fibres continued from the innermost edge of this muscle are joined, at a point where the muscle divides into its humeral and dorso-epitrochlear portions, by the outermost of the two slips into which the ventral panniculus splits at its upper part. This compound slip joins the inferior surface of those fibres of the pectoralis major which are derived from its upper stratum, at their junction with the terminal tendon.

The above-described offset from the latissimus dorsi evidently answers to a muscular "abnormality" occasionally found in man, and termed "Achselbogen" by the German anatomist Langer. It is, however, regarded by Prof. Macalister (*loc. cit.* pp. 54, 55) as a fourth pectoral muscle.

Where the above-mentioned fibres diverge from the dorso-epitrochlear factor, a slip arose from the internal surface of the muscle, and soon passed into a stout flat tendon, which, passing between the median and circumflex vessels and nerves,

ends at the humerus beneath the middle portion of the terminal tendon of the pectoralis major.

The dorso-épitrochlien, instead of being a continuation of the latissimus dorsi, appears rather to be tacked on to its outer edge by a kind of faint tendinous seam. This offset passes as a thin, but quite distinct, muscular investment over the olecranon, along the flexor aspect of the forearm, and terminates in the palmar fascia.

Over the dorso-épitrochlien passes the internal cutaneous nerve, which runs over the flexor surface of the forearm as far as the wrist.

The pectoralis major had no clavicular origin. At the uppermost portion of its sternal origin it can be divided into two more or less distinct strata, with the inferior (deep) surface of the lowest of which the panniculus carnosus is connected. The upper stratum of the muscle joins the lowest portion of the terminal tendon, the lower the uppermost—enclosing thus a sac having the concavity upwards.

The tendon is inserted along the ridge running from the external tuberosity to the deltoid trochanter.

A layer of connective tissue, but no fascia, intervenes between the two layers into which the muscle may be differentiated.

The pectoralis minor is absent, unless the lowermost of the two layers of the pectoralis major just mentioned be regarded as its homologue.

Of the coraco-brachialis I could not find a trace on either side, not even of the "short" variety of Wood. This muscle, which is usually present, in one of its three forms at least, in mammals, is wanting also in the Chlamydophore, according to Prof. Hyrtl.

The biceps was single-headed. Halfway down the arm its most posterior fibres separate, and fuse with the brachialis anticus, while the anterior portion of the muscle is continued into a stout rounded tendon, which is inserted into a strong tubercle projecting from the palmar surface of the radius. This part of the muscle must act as a strong supinator. That portion of the biceps which is blended with the brachialis anticus is inserted in company with this muscle into the ulna.

The biceps arises by a flat tendon from the superior edge of the glenoid cavity of the scapula, and passes over the head of the humerus, covered by the capsular ligament.

The brachialis anticus takes origin from the anterior and external aspect of the humerus, below the deltoid tuberosity.

The triceps is made up of the usual factors. The "k— head" of anthropotomy takes origin from the upper fou

of the axillary costa of the scapula, just posterior to the glenoid cavity, and joins that portion of the muscle which rises from the humerus. This latter portion is bifid at origin, the musculo-spiral nerve passing between the two heads, one of which arises from the posterior surface of the shaft of the humerus, as high up as the neck of the bone, while the other takes origin immediately behind the insertion of the deltoid, and is joined by the "long" head.

From that portion of the humerus which answers to the olecranon-fossa of human-anatomy language arise some fibres (anconeus) which join the main body of the muscle. These are limited above by the musculo-spiral nerve, from which they receive a special branch. The insertion of the triceps was as usual.

There was a well-developed epitrochleo-anconeus, passing from the internal condyle to the olecranon, and having the usual relation to the ulnar nerve.

The supinator longus was well developed. It arose from a ligament stretched between the deltoid tubercle and the "supinator ridge" of the humerus. Before reaching its insertion it separates into two strata, the lower of which terminates at the distal extremity of the radius, while the upper is lost in fascia covering the inner and dorsal aspects of the wrist, and also joins obliquely the anterior annular ligament of the carpus. The lower layer seems to be in its turn differentiable into two strata. To the muscle is distributed branches from the posterior interosseous nerve, just anterior to the emergence of the musculo-spiral nerve from beneath the ligamentous bridge mentioned above.

The upper stratum of the supinator longus is thus described in the explanation of Cuvier's plates:—"Muscle propre (G. Cuvier) c'est un 2e long supinateur" (pl. 257. fig. 1, & pl. 258).

The supinator brevis was also well developed. It arose from the external condyloid ridge of the humerus, covered by the origins of the common extensor and of the extensor ossis metacarpi pollicis, and was inserted along the whole of the outer edge of the radius, coextensively with the radial origin of the flexor profundus. The muscle was pierced at its origin by the posterior interosseous nerve.

The extensor carpi radialis arises from the humerus, immediately below the supinator longus. It is a large, but single muscle. It becomes tendinous at the distal third of the forearm; and the tendon passes under a ligamentous pulley at the wrist-joint, to be finally inserted into the radial side of the third metacarpal bone, being previously crossed by the "dorsal interosseous" muscle (Cuv.), which passes to the terminal phalanx of the index.

The extensor ossis metacarpi pollicis arises from the external condyloid ridge, in company with the extensor communis digitorum and the extensor minimi digiti. It passes obliquely (the hand being pronated) over the tendon of the extensor carpi radialis, and is inserted by a strong tendon into the rudiment of the pollex (or trapezium?).

The extensor communis digitorum takes origin from the external condyloid ridge of the humerus, immediately below the extensor carpi radialis, but in company with the muscle just described. At the carpal joint its tendon is closely bound down by a strong ligament stretched between the distal end of the radius and the dorsal surface of the cuneiform bone, and terminates at the dorsal aspect of the base of the distal phalanx of the third ("middle") digit, being reinforced, close to its termination, by a short extensor (dorsal interosseous, Cuv.) on either side.

The extensor brevis digitorum manus, a kind of accessory extensor muscle, arose from the distal end of the dorsum of the ulna, and from the dorsum of the os magnum and unciform bone. The principal portion of the muscle passes to either side of the tendon of the extensor communis, just short of its termination at the nail of the third digit. A thin slip, given off from the radial side of the muscle, and which also arises from a ligament joining the scaphoid and lunar bones, is inserted by tendon into the base of the ungual phalanx of the index. This muscle, to which the symbol of the dorsal interosseus is appended in Cuvier's plates, answers to one which Prof. Macalister describes (*loc. cit.* p. 62) as present in *Bradypus*, and which "seems," he says, "to contain the displaced germs of the dorsal interossei."

From the external condyle of the humerus, immediately below and in company with the extensor minimi digiti, and from the proximal two-thirds of the outer surface of the ulna, arises a muscle which is inserted by tendon into the ossicle (rudiment of fifth digit) which lies to the ulnar side of the unciform bone and the rudiment of the fourth digit. This is not improbably the extensor carpi ulnaris.

A well-developed muscle takes origin from the external condyloid ridge, in company with the extensor ossis metacarpi pollicis and the extensor communis, and has a broad tendinous insertion into the ulnar side of the base of the proximal phalanx of the third digit. This may be a displaced extensor annularis or extensor minimi digiti.

The pronator teres, a muscle of uniform width, arises from the ridge above the inner condyle, and is inserted by a flat tendon into the distal end of the radius, being covered at its

insertion by the lower layer of the supinator longus. There was, as seems to be the case in all Edentata yet examined, no trace of a coronoid head*.

The pronator quadratus was exceedingly well developed. It covers the palmar surface of the radius and ulna from their distal end up to the insertions of the biceps and brachialis anticus. Meckel makes no mention of this muscle, nor does it appear in Cuvier's plates. The pronator quadratus is present in all Anteaters, both American and African.

A muscle (palmaris longus?) arises from the olecranon, in close connexion with the dorso-épitrochlien. Its tendon passes to the radial side of the wrist, where it terminates in the palmar fascia.

A large mass of muscle arose from the tip of the pisiform bone, and was attached on one side to the rudiments of the fourth and fifth digits, on the other to the rudimentary pollex, while anteriorly it was continued into the palmar fascia.

The muscles attached to the pisiform, one of the most important bones, *functionally* considered, in the manus of the animal with whose anatomy we are concerned, are very numerous; but their homologies are by no means easy of determination†.

From the lowest portion of the inner condyloid ridge of the humerus rises a muscle (flexor carpi ulnaris?) which soon divides into two slips, the upper of which terminates by tendon at the anterior part of the os pisiforme, while the inferior slip has a broad fleshy attachment to the lower or palmar surface of the same bone.

A muscular mass arose from the lower third of the dorsum of the ulna, and was inserted into the upper part of the pisiform bone.

Another and larger mass took origin from nearly the whole length of the inner (ulnar) edge of the ulna, and was inserted into the pisiform immediately below the muscle just described.

Cuvier figures (pl. 257. fig. 1) a muscle as arising from the lower third of the ulna and terminating at the tip of the pisiform bone: this he terms "abaisseur du pisiforme."

Meckel describes a muscle coming from the tip of the olecranon, and inserted at the inferior free edge of the pisiform, which bone it draws away from the two great fingers (*i. e.* index and digitus medius). Another muscle (according to him, lying in the same plane) takes origin from the distal

* Prof. Macalister, "On the Nature of the Coronoid Portion of the Pronator Radii Teres," Journ. Anat. & Phys. ser. 2. vol. i. p. 9.

† "Die Beugeseite der Hand," says Meckel (Archiv, p. 47), "enthält dagegen wenigstens *sechs* verschiedene, kleine Muskeln, welche grösstentheils dem grossen Erbsenbein angehören."

end of the ulna, and is also inserted into the pisiform, which it draws outwards and backwards. This seems to answer to the "abaisseur" of Cuvier.

An analogous muscle, he says, arises from the flexor tubercle of the humerus, and is attached to the anterior end of the tip of the pisiform, of which it is likewise an abductor.

These muscles, of which I have given both Meckel's and my own description, appear to be factors of a highly differentiated flexor carpi ulnaris.

From the internal condyloid ridge, immediately below the origin of the pronator teres, and covering the origin of the flexor carpi radialis, arises the flexor sublimis of the third digit. Immediately below, and in company with the condyloid origin of the flexor profundus and flexor carpi ulnaris, the flexor sublimis of the index arises. Their tendons pass over the anterior annular ligament of the wrist, and, after splitting to allow of the passage of the tendons of the deep flexor, are inserted into either side of the distal end of the first phalanx of their respective digits.

The flexor profundus has two large heads of origin:—

1. From the upper half of the ulnar edge of the radius, being coextensive with the insertion of the supinator brevis.

2. To a like extent from the inner (ulnar) edge of the ulna, and from the homologue of the coronoid fossa of anthropotomy*, also by a strong tendon from the internal condyloid ridge. The stout common tendon passes under the anterior annular ligament (which intervenes between it and the superficial flexors); and its terminal branches pass to the bases of the ungual phalanges of the two functional digits.

A thin muscular slip arises from the tendon of origin of the flexor profundus from the condyle, and is inserted by a delicate tendon into the dorsal aspect of the anterior annular ligament.

A strong ligamentous strap binds down the tendons of the flexores sublimes and profundi at the point where the latter pierce the former.

According to Meckel (Vergleich. Anat. iii. p. 559), the third digit only has a "perforated" flexor.

The slip which passes to the annular ligament seems to be a rudimentary homologue of a muscle which is present in *M. tamandua*, and is termed by Rapp (Anat. Untersuch. über die Edentaten, p. 48) "Spannmuskel des *Ligamentum annulare*."

* This slip appears to answer to one which I have described and figured (Trans. Linn. Soc. vol. xxvi. p. 546, and pl. 44. fig. 1) as existing in *Dasypus*.

The tendon of the deep flexor does not contain any sesamoid bone.

From the ulnar side of the deep flexor tendon of the third digit, just before it passes under the "perforated" flexor, is given off a comparatively small tendinous slip, which becomes muscular, and has a fleshy attachment to the radial side of the last division of the rudimentary fourth digit.

From the angle formed by the junction at origin of the deep flexor tendon of the index with the tendon for the third digit rises a vermiform muscle, similar to the one just described, which is attached to the radial side of the proximal phalanx of the third digit.

These two muscles are probably lumbricales—muscles which, according to Prof. Macalister (Ann. & Mag. Nat. Hist. July 1869, p. 61), are absent in the Aï.

The interossei are five in number:—

1. A fairly developed muscle, arising by a tendon from the inferior process of the unciform bone, and passing to the ulnar side of the base of the proximal phalanx of the third digit.

2. Above this arises, from the ulnar side of the unciform process, another and smaller muscle, which passes to the rudiment of the fourth digit.

3. A fair-sized muscle, terminating at the ulnar side of the proximal phalanx of the index, and arising from the middle of the palm, from adjacent parts of the bones of the two metacarpals.

4. A delicate muscle arises from the unciform bone, covered by the muscle described above as passing to the third digit. It runs obliquely across the palm; and its delicate tendon seems to join the muscle which goes to the index.

5. To the radial side of the proximal phalanx (metacarpal ?) of the index passes a muscle from the rudimentary pollex (trapezium ?).

The gluteus maximus was represented by a thin muscular sheet inserted by a strong tendon into the middle of the outer edge of the femur, at about the point where the third trochanter would be looked for. According to Meckel (Archiv, p. 48, and Vergleich. Anat. p. 577), the insertion is along the *whole* of the outer edge of the femur. The tendon is continuous anteriorly with the fascia in which the "portion ventrale" (Cuv.) of the panniculus terminates. The muscle arises from the crest of the ilium and from that edge of the bone which is in apposition to the sacral vertebræ, also from an aponeurosis which covers the origin of the caudal muscles.

The gluteus medius is a thick muscular mass which takes origin from the whole of the external (gluteal) fossa of the

ilium, and is inserted into the upper and outer aspect of the trochanter major. The lower border of the muscle is separated from a subjacent muscle (the quadratus femoris?) by the sciatic vessels and nerve.

I can confirm Meckel's statement (Archiv, p. 49) that no gluteus minimus is present—that is to say, separable from the gluteus medius. All three glutei are, according to Rapp (*op. cit.* p. 50), present in *M. tamandua.*

A large muscle arises from the obturator foramen, and forms its pubic and ischial boundaries, and is inserted into the inferior part of the great trochanter. This is probably the obturator externus; but it closely resembles the muscle figured by Cuvier (pl. 257. fig. 2) as quadratus femoris.

A muscle, fan-shaped, tapering to its insertion at the under surface of the great trochanter, betwixt the insertion of the gluteus medius and the muscle just described, takes origin from that part of the ischium which lies below (or posterior to) the acetabulum. This muscle, which is most probably the quadratus femoris, though it may possibly be the homologue of either the pyriformis or the gemelli, is covered by the origins of the biceps and semitendinosus; and the sciatic nerve, moreover, passes over it. Cuvier attaches to it (pl. 257. fig. 2) the symbol of the pyriformis.

The psoadiliacus has an extensive insertion, the iliac portion being prolonged for some distance on the shaft of the femur. The psoas factor is chiefly inserted into the lesser trochanter. The iliac portion is separated from the psoas parvus, just before the latter becomes tendinous, by a nerve (the external cutaneous?). A few fibres from its external edge are prolonged on to the rectus femoris, and blend with it.

The psoas parvus (which is not represented in Cuvier's plates) is inserted by a strong shining tendon into a small and sharp tubercle lying in advance of the root of the slightly convex inner face of the ilium and the junction of the os pubis with this bone.

As the animal was so "well ribbed home," to use a veterinary expression, I could not examine the origins of the psoas parvus and psoadiliacus, a perfect skeleton being required for the museum of the College of Surgeons.

The pectineus, a well-developed, fan-shaped muscle, arose from the superior edge of the iliac portion of the pubis, covered by the highest fibres of origin of the gracilis, and had a fleshy insertion into the inner side of the femur from below the lesser trochanter to a point just above the inner condyle.

The adductors seemed to be represented by two muscles.

1. arose from the rest of the anterior ramus of the os pubis,

in advance of the pectineus, as far as the symphysis. It soon split into two slips, one of which was inserted tendinously into the lower surface of the femur, slightly in advance of the insertion of the *pectineus*, while the other terminated (partly fleshy, partly tendinous) at the inner condyle, above and covering the insertion of the superior factor of the semitendinosus.

2. took origin from the same portion of the pubic bone as the preceding, lying between it and part of the origin of the gracilis. It widens out gradually toward the insertion, which is into nearly the whole length of the outer part of the inferior surface of the femur, being coextensive with the origin of the femoral portion of the biceps.

A small muscle arising from the pubis, below the lowest fibres of origin of the pectineus, was inserted into the intertrochanteric space on the inferior surface of the femur.

The quadriceps extensor did not present any peculiarities worthy of note.

The sartorius arose from strong fascia attached to the tendon of the psoas parvus, and from Poupart's ligament, and was inserted, above and slightly external to the gracilis, into the tibia, close to the boundary of the articular surface of the bone. Part of its terminal tendon appeared to be prolonged upwards to the patella. A like inward displacement of the sartorius from its usual origin has been described by Meckel (Vergleich. Anat. iii. p. 614) and Prof. Macalister (*loc. cit.* p. 64) as taking place in the Aï, by Krause* in the Rabbit, by Prof. Hyrtl in the Chlamydophore †, and by myself (Trans. Linn. Soc. vol. xxvi. pp. 553, 592) in *Dasypus* and *Orycteropus*.

The gracilis has a <-shaped origin (left side) from the edge of the os pubis, and for about two-thirds of the ischio-pubic bone, and is inserted by a broad tendon into the upper third of the inner edge of the tibia, the upper terminal fibres covering the strong internal lateral ligament.

The semitendinosus took origin in two slips from the tuber ischii.

1. The superior, which was fused with the biceps at origin, was inserted into the posterior part of the inner condyle of the femur, just below the insertion of the adductor, and posterior to the internal lateral ligament.

2. The inferior rises just below the former, covered by the most inferior fibres of origin of the gluteus maximus, and joins

* Die Anatomie des Kanincheus, p. 116. Leipzig, 1868.

† "*Sartorius* insolita plane excellit origine, dum non ab ossis ilei spina, sed a tendine psoico enascitur."

the middle of the terminal tendon of the gracilis, being covered by this muscle at insertion.

The semimembranosus arises from the tuber ischii below the second portion of the semitendinosus, covered by the lowest fibres of origin of the gracilis, and is inserted tendinously into the tibia, posterior to the internal lateral ligament, and midway between the terminations of the two fascicles of the semitendinosus. Cuvier represents (pl. 258. fig. 2) this muscle as made up of two slips, which are inserted just above the "accessoire fémoral du demi-nerveux."

The biceps femoris arose from the tuber ischii in company with the superior division of the semitendinosus, and was inserted into the outer part of the tubercle of the tibia which affords insertion to the ligamentum patellæ by a strong tendon continuous with the fascia covering the outer aspect of the leg.

An accessory portion (Cuvier), quite distinct from the above, fan-shaped, took origin from that part of the outer edge of the femur which is included between the great trochanter and the termination of the gluteus maximus. It gradually tapered towards its insertion (passing in its course over the peroneal nerve), which was effected by tendon into the fibula, at the junction of its third with its lowest fourth.

The gastrocnemius was made up, as usual, of two muscular bellies:—

1. Outer, rising from the outer aspect of the external condyle, between the origin of the plantaris and the external lateral ligament, the innermost and deeper fibres of origin arising from the sesamoid from which the popliteus takes origin.

2. Inner and larger, rising from the inner and inferior surface of the internal condyle. These bellies unite, about halfway down the calf, into a tendo Achillis, which is inserted into the calcaneum.

The soleus, a very well-developed muscle, arose from the fibula for about three-fourths of its length, and was inserted by a strong tendon into the calcaneum, in advance of the tendo Achillis.

The popliteus was well developed. It arose from an elongated sesamoid bone (Meckel, Archiv, pp. 28, 53) which projects at the inferior aspect of the knee-joint, posterior to the external lateral ligament. It then passed obliquely downwards to its insertion at the upper third of the tibia, the lower border of its terminal portion blending with the tibial fibres of origin of the tibialis posticus.

A similar sesamoid is present in the head of the popliteus

in the Aï, according to Meckel (Vergleich. Anat. iii. p. 635) and Prof. Macalister (*loc. cit.* p. 66), and in *Nycticebus tardigradus*, according to Mr. Mivart and Dr. Murie (Proc. Zool. Soc. Feb. 1865, p. 251). It is significant that Prof. Macalister has recorded (Journ. of Anat. ser. 2. vol. ii. p. 108) the occurrence of a sesamoid in the tendon of origin of the supinator brevis in a female human subject, which muscle he considers to be the serial homologue of the popliteus.

The plantaris arose from the lower surface of the femur, behind the external condyle, in advance of the origin of the femoral head of the biceps. The muscle is continued into a long slender tendon, which passes under the gastrocnemius to the inner side of the leg, and, after broadening out, is inserted partly into the calcaneum, partly into the extremity of the strigil-shaped accessory bone of the tarsus. The termination of this muscle is unlike that which is usual in the Edentata (Macalister, *loc. cit.* p. 66), since it is not prolonged into the sole.

The tibialis posticus arose from the middle of the posterior surface of the tibia, just below the insertion of the popliteus, with which it is here blended, also from the posterior part of the head of the fibula. Its tendon passes under a strong ligamentous pulley at the internal malleolus, and is inserted into the fibular and inferior aspect of the strigil bone, not far from its free extremity.

A muscle arose from the inner aspect of the head of the fibula, covered by the origin of the tibialis posticus. It soon became tendinous; and its long tendon passed obliquely to the inner side of the calf, and at the inner malleolus ran under a pulley situated posterior to and slightly below that under which the tendon of the tibialis posticus passes. It was inserted into the fibular side of the strigil bone, close to its base and in advance of the insertion of the tibialis posticus. This muscle, if not a differentiated slip of the tibialis posticus, which it most probably is, may be the flexor longus hallucis. Prof. Hyrtl describes, under the name of "tibialis posticus accessorius," a similar muscle as present in *Chlamydophorus*, "qui tibialem posticum viæ comitem laborisque socium legit." I found a like muscle in *Dasypus* (Trans. Linn. Soc. xxvi. p. 558); and Mr. Wood records (Proc. Roy. Soc. June 1865) the occasional occurrence of such in the human subject.

The flexor longus digitorum was a strong bipenniform muscle, arising from the upper three-fourths of the tibia and fibula. It became tendinous on reaching the sole; and the branches of its tendon terminated each at one of the four functional digits of the foot.

The flexor accessorius was well developed, and arose from the under surface of the calcaneum, and, passing obliquely inwards across the plantar aspect of the tendon of the common flexor, was inserted into it just posterior to its division into digital slips.

The peronei were three in number. They all arose from the upper part of the fibula; and their tendons passed through a strong ligamentous pulley stretched between the external malleolus and the calcaneum.

The most anterior at origin (peroneus longus) took origin in close company with the origin of the long extensor of the toes. Its tendon lay outermost of the peroneal tendons, under the ligamentous band, soon after leaving which it passed under a second pulley situated on the fore part of the calcaneum, and, running along the fibular side of the foot, passed into the sole along the plantar aspect of the cuboid bone, and was finally inserted into the fibular side of the scaphoid, on its plantar aspect. This muscle was separated from the other peronei, at origin, by the peroneal vessels and nerve. Its tendon did not send any offset to the fifth digit.

The two other peronei were fused into one muscle; but in the ligamentous pulley the compound tendon divided into two unequal slips, the smaller of which passed to the side of the base of the proximal phalanx of the fifth digit (peroneus tertius or quinti digiti?). The other, and by far the largest, slip terminated at a tubercle on the base of the fifth metacarpal, broadening out at its insertion (peroneus brevis).

The tibialis anticus, a very well-developed muscle, arose from the upper half of the tibia and from the middle third of the fibula. Its very strong single tendon passed under the common annular ligament, to be inserted into the posterior and inferior process of the ento-cuneiform bone, covering at insertion a transverse ligament passing from this bone to the base of the strigil bone.

Meckel (Vergleich. Anat. p. 624) describes this muscle as having two heads of origin, but states that the tendon terminates at the rudimentary hallux.

The extensor communis digitorum arose from the head of the fibula, in company with the peroneus longus, and from the adjacent part of the tibia. Its tendons passed under the broad, common (annular) ligament, and then under a very strong ligamentous bridge (proper to it alone) which is fastened to a process from the anterior part of the astragalus. On the dorsum of the foot it expanded into a web which was fastened to the bases of the proximal phalanges of the toes, including the rudimentary hallux, and was also, except in the case of

the latter digit, continued to the root of the ungual phalanx of each toe, being reinforced at the sides of the digit by the tendons of the interossei.

The extensor brevis digitorum was well developed. It arose from the upper and anterior portion of the os calcis, from the anterior part of the astragalus, and from the fibular side of a strong ligament passing from the latter bone to the entocuneiform. It appeared to be divisible into four slips, the innermost of which was continued into a tendon which pierced the aponeurotic web of the common extensor tendon at the base of the proximal phalanx of the second toe, and then ran along the dorsal aspect to the tip of the hallux.

The three outer slips seemed to be inserted principally into the bases of the proximal phalanges of the three outer toes, besides being connected with the under surface of the expansion of the common extensor tendon.

The extensor proprius hallucis arose from the lower fourth of the fibula, and became tendinous on reaching the dorsum of the foot. The long slender tendon joined the aponeurotic web of the common extensor tendon at the metacarpal of the second digit.

A large muscle arose, partly fleshy, partly tendinous at origin, from the whole length of the inferior edge and fibular side of the strigil bone, and, by means of a tendon, from a tubercle on the inferior surface of the astragalus. It had a broad fleshy insertion into the base of the rudimentary hallux (abductor hallucis?). By means of those fibres which pass to the astragalus, it would seem that the strigil bone could be slightly raised and approximated to the calcaneum.

From a ligament stretched across the sole at the line of articulation of the first with the second row of tarsal bones, arose a muscle which passed to the fibular side of the base of the rudimentary hallux. This is not improbably the representative of the adductor hallucis.

The muscles proper to the fifth digit were as follow:—

A long fusiform muscle arose from the inferior surface of the os calcis, and, after passing beneath the flexor accessorius, terminated at the fibular side of the base of the proximal phalanx (abductor digiti quinti?).

Another arose from the outer side of the os calcis, and was inserted into the tubercle at the base of the metacarpal (flexor brevis digiti quinti?).

A muscle was inserted into the fibular side of the base of the proximal phalanx, which appeared to arise from the tubercle of the metacarpal. Is this an interosseous muscle, or is it an anterior segment of the flexor brevis?

The lumbricales were three in number. They arose from the common tendon of the flexor communis, at the angle of origin of the branches destined for each toe. They appeared to pass to the tibial sides of the three outermost toes, and to terminate by delicate tendons at the point where the deep flexor tendons are bound down to the toes by ligamentous straps. Meckel makes no reference to them, nor does Cuvier figure them.

The interossei were very well developed, being stronger than those of the palm. They were seven in number, and arose from the plantar surface of the second row of tarsal bones. Each ended in a broad tendon, which joined on either side the extensor tendon of its proper digit. Each toe, the fifth excepted, had one on either side, the latter only on its fibular side. The hallux had none. On the extensor surface of the foot, from the ligament connecting the astragalus with the ento-cuneiform bone, and from the side of this latter, passed a muscle to the tibial side of the proximal phalanx of the second digit. This is the *tibial* interosseus of the second digit.

Superficially, on the plantar aspect of the foot, lies a large muscle, which is attached on one side to the strigil bone, and on the other to the metatarsal tubercle of the fifth digit, as well as to a ligament passing from this to the calcaneum. This muscle seems to correspond, *functionally* at any rate, to the large palmar muscle which is attached to the pollex and to the pisiform bone.

The ligamentum teres of the hip-joint was well developed. It is absent in *Bradypus*, according to Prof. Macalister (*loc. cit.* p. 65) and according to Meckel. Rapp (*op. cit.* p. 45) remarks that it is absent in the Sloths and the *Manis*.

Though the carpal and tarsal bones of the Two-toed Anteater have been described both by Meckel and Cuvier, I am not aware that they have ever been figured in detail; for though there is an excellent representation of the complete skeleton of the animal in De Blainville's 'Ostéographie,' the number and arrangement of these bones can by no means with certainty be determined. I have therefore thought it advisable, notwithstanding that my paper professes to deal with myology only, to add a plate comprising figures of the fore and hind paws and the carpal and tarsal bones of this curiously modified Anteater.

That which Brants* has remarked relative to the muscles

* Dissertatio Zoologica Inauguralis de Tardigradis, p. 27. Lugdun. Batav. 1828.

of the limbs of the Sloths appears to be fairly applicable to the Two-toed Anteater, namely, "Vires motrices anticæ corporis partis esse, posticam vero validis musculis ad anteriorem attrahi atque hujus motus sequi debere,"—and the more so when we contrast the short humerus, rugged with strong muscular ridges, with the long smooth femur, which lacks even a rudiment of a third trochanter.

In addition to a long prehensile tail (at best but a stunted member in the sloths), naked for the lower third of its length, the fore and hind feet (Pl. VIII. figs. 1 to 4) are marvellously modified for arboreal progression, the functional absence of the pollex being compensated for, as Meckel hints (Archiv, p. 48), by the enormous development of the pisiform bone (figs. 5 to 8), to which are attached numerous strong muscles, while a long strigil-shaped bone* (fig. 11), passing backward from the scaphoid, more than makes up for the comparative shortness of the calcaneal process.

EXPLANATION OF PLATE VIII.†

Fig. 1. Right fore foot, inner side.
Fig. 2. Foreshortened palmar view of the same.
Fig. 3. Right hind foot, inner side.
Fig. 4. Plantar surface of the same.
Fig. 5. Dorsal view of radius and ulna and proximal row of carpal bones, left side.
Fig. 6. Dorsal view of carpal and metacarpal bones, right side.
Fig. 7. Palmar aspect of the proximal row of the carpal bones, left side‡.

* This bone, termed "schaufelförmiger" by Meckel, is not unlike the instrument used by the Romans when perspiring in the bath: hence the name which I have applied to it. Those who prefer a long Latinized name, may call it *strigiliform*. Meckel considered that it was probably a homologue of the bone which carries the spur in the Ornithorhynchus; and Cuvier, in his 'Ossemens Fossiles' (nouvelle édit. Paris, 1823, tome v. 1ère partie, p. 108), makes the following remarks relative to its probable function :—"Un os surnuméraire articulé sur le cunéiforme interne, et qui, dans le Tamanoir, le Tamandua, et les Pangolins, est triangulaire et fort petit, mais qui, dans le petit Fourmilier, s'allonge et s'élargit de manière à former une sorte de talon ; il est vrai que dans cette espèce le calcanéum est extraordinairement court, ne se portant point en arrière plus que l'astragale lui-même. Cet os surnuméraire est ce qui donne à la plante du pied du petit Fourmilier cette forme concave qui la rende si propre à embrasser les branches et à grimper aux arbres."

† The figures of bones are taken from a non-articulated skeleton, somewhat imperfect, belonging to the Royal College of Surgeons.

‡ The os lunare on this side was divided into two bones of equal size, but was single on the right side of the skeleton, and on both sides in the specimen which I dissected. Whether this division be due to a fracture, which is improbable, or be the result of a development from two distinct osseous centres, is a doubtful question.

Fig. 8. Lateral view (ulnar) of carpal and metacarpal bones, right side*.
Fig. 9. Dorsal view of metacarpals and phalanges, left fore foot.
Fig. 10. Lateral view (radial) of the same.
Fig. 11. Inner view of bones of left hind foot.
Fig. 12. Right hind foot, fibular view.
Fig. 13. Tibial view of the same (the strigil bone being removed).

Fore foot:—

ul. ulna.	*ps.* pisiform.
r. radius.	*mg.* magnum.
sc. scaphoid.	*un.* unciform.
l. lunar.	*mc.* metacarpal.
c. cuneiform.	*ph.* phalanx.

Hind foot:—

t. tibia.	*st.* strigil bone.
f. fibula.	*ic.* internal cuneiform.
cl. calcaneum.	*mc.* middle "
cb. cuboid.	*xc.* external "
sc. scaphoid.	*mt.* metatarsal.
as. astragalus.	*h.* hallux.

The numbers II. III. IV. V. indicate digits.

XXX.—*Additional Notes on Sea-bears* (Otariadæ). By Dr. J. E. Gray, F.R.S. &c.

Professor Turner, of Edinburgh, has kindly left with me for examination three skulls of a species of Sea-bear from "Tuesday Bay, Desolation Island" (which is, no doubt, the Desolation Land of the charts, on the south-west coast of Patagonia), and a skull that was presented to the Anatomical Museum of the University of Edinburgh by the late Professor Goodsir, who received it, with the cranium of a Caffer, from Mr. C. Bell, as a "seal-head from the Cape of Good Hope."

The skulls from Desolation Island evidently belong to the species which I have described as *Euotaria nigrescens*, the usual Fur-Seal of the Falkland Islands and other parts of the coast of South-west America.

Two of the skulls are from adult animals, are without the lower jaws, and have only a few worn and broken teeth, having been rolled on the beach.

The other skull is of a young animal, exactly similar to the

* The mechanism of the grasping-action of the fore foot appears to be as follows:—The pisiform, by the contraction of the large palmar muscle, is brought into a line with the long axis of the forearm; the flexor muscles contract; but the third metacarpal cannot be brought into a position of less than a right angle with the pisiform, owing to the impingement of the downward process of the unciform against the latter bone; the ungual phalanges, however, of the two functional digits, free to act, are drawn down into apposition against the vicarious pollex.

skull of a young *Euotaria nigrescens*, n. 1013 *e*, in the British-Museum collection. The front edge of the hinder nostrils is as arched as in that specimen; the teeth are rather more developed and larger than in our skull; they have a well-marked central lobe and a distinct small acute tubercle on the front edge of the cingulum.

The two adult skulls are very like the adult skull of *E. nigrescens*, 1013 *d*, in the British Museum; but the opening of the internal nostrils is narrower, and their front edge in one is not nearly so angular, and in the other it is rather more arched than in either of the other two skulls, showing that the size of the posterior nasal aperture and the form of its front edge vary in different specimens of this species.

The comparison of the young skull with the more adult one shows that the grinders change their position considerably as regards the front edge of the hinder nasal opening. In the young skull of *Euotaria nigrescens* the hinder end of the tooth-line is very near (not a quarter of an inch from) a line level with the front edge of the internal nasal opening, and the hinder part of the palate in front of the aperture is nearly as broad as the middle of the palate: in the adult skull the hinder end of the tooth-line is a full inch from the front edge of the internal nasal opening, the hinder part of the palate is contracted toward the internal nostril, and the internal nasal opening is lengthened and narrowed; but the real position of the teeth, as compared with the front part of the zygomatic arch, is little altered, though the form of the palate gives them the appearance of being more changed than they really are.

These skulls are interesting as showing that *Euotaria nigrescens*, like *Otaria leonina* and *Morunga elephantina*, are common to the Falkland Islands and the west coast of South America.

The chief character by which the adult skull of *Euotaria nigrescens* can be distinguished from the adult skull of *Arctocephalus Delalandii* is, that the hinder or fifth upper grinder and the penultimate or fourth are placed rather in front of the hinder edge of the front part of the zygomatic arch; but the position of the teeth is most distinctive in the skull of the young animal, and loses much of its importance in comparing old skulls together, unless the skulls and teeth are very accurately compared; and even then the distinction is more imaginary than real.

The skull from the Cape of Good Hope has been described and figured by Dr. Turner under the name of *Arctocephalus schisthyperoës*, in the 'Journal of Anatomy and Physiology,'

vol. iii. p. 113. The name is changed to *A. schistuperus* by Dr. Günther in the 'Zoological Record' for 1868, p. 20. It is evidently the skull of a half-grown animal, with all its teeth developed, but with the sutures of the bones still apparent. It agrees in every respect with what I should expect to be the form and structure of the skull of *Arctocephalus Delalandii* from the Cape; but unfortunately the two skulls of that Sea-bear from the Cape which are in the British Museum are from old animals; and the specimen figured by Cuvier, Oss. Foss. v. 220, t. 18. f. 5, is also adult. It differs from the skulls of the two adult specimens of that species in the British Museum in the hinder nasal aperture being much extended forwards and gradually tapering to a point in front, which reaches to the transverse palato-maxillary suture. This peculiarity in the form of the palate, which Prof. Turner has not observed in any other seal-skull, seems to have induced him to regard it as a distinct species.

From the examination I have made of the skulls of seals in the Museum and other collections, I am induced to believe that it is an individual abnormality of *Arctocephalus Delalandii*. I have observed a similar malformation in the palates of two other species. I was myself misled by their structure to regard a skull with such a deformity as a distinct species before I met with the other examples.

At one time I thought that it might be a peculiarity of the young state, as it had up to that time only been observed in skulls of half-grown animals. I have observed it in half-grown specimens of *Euotaria nigrescens*; but the skulls of the very young specimens of this seal in the British Museum have the front edge of the hinder nasal opening truncated and slightly arched in form, with well-developed square palatine bones united by a straight central suture, just as in the adult, but broader and straighter.

It was this observation that induced me to return to my original opinion, that the skull which I had at first regarded as a young skull of *Arctocephalus monteriensis* (Proc. Zool. Soc. 1859), and then as a separate species under the name of *A. californianus* (Cat. Seals and Whales, p. 51), was only monstrosity of *A. monteriensis*, as I did in the Ann. & Nat. Hist. 1866, xviii. p. 232; and I am now induced to believe that *Arctocephalus schisthyperoës* is only an imperfectly developed skull of *Arctocephalus Delalandii*, or, as it ought to be called, *A. antarctica*.

Dr. J. R. Forster, in Cook's Voyage in 1775, observed the Eared Seal at the Cape of Good Hope, and called it *Phoca ursina*. Believing it to be the same as the Sea-bear he had

observed in New Zealand, Thunberg, in his list of Cape mammalia in the third volume of the Transactions of the St. Petersburg Academy, iii. 322, notices this animal under the name of *Phoca antarctica.* (See Fischer, Syn. Mam. p. 242.) Dr. Peters has applied the name of *Otaria pusilla* to this species, believing it to be the *Petit Phoque* of Buffon, which has been named *Phoca pusilla* by Schrober, and had before been named *Phoca parva* by Boddaert. Buffon says that it came either from India or the Levant; but it is not by its description to be distinguished from a young specimen of almost any of the species. It is as likely to have come from the Falkland Islands as from the Cape, as the French had traffic with les Iles Malouines, as they call them.

Mr. Gill considers Steller's Sea-bear (*Callorhinus ursinus*) to be the type of M. F. Cuvier's genus *Arctocephalus*, and therefore abolishes *Callorhinus* and gives the new name of *Halarctus* to the true *Arctocephali*—thus unnecessarily adding to the confusion of the generic names of these animals. He fell into this mistake by not observing that *Phoca ursina*, and even *Otaria ursina*, had been applied to several species, from very different localities, that F. Cuvier established his genus on the skull of *P. ursina* of Forster, from the Cape, which he (M. Cuvier) had named *Phoca Delalandii*, and that F. Cuvier does not figure a skull of the Sea-bear of Steller: indeed the French collection did not at that time, nor does it even now possess one; and I feel assured that if it had, F. Cuvier would, according to his custom, have established for it a genus distinct from *Arctocephalus*, the skulls of the two genera being of such distinct forms.

Dr. Peters, in his two papers on the Eared Seals (*Otaria*), uses the length of the ears and the existence or non-existence of the under-fur, as well as the characters used by Mr. Gill and myself, to separate the species of these animals into subgenera.

The length of the ears may probably afford good characters for the separation of the species and groups, if they can be observed in the living animals. As yet, only one species of these animals, the Sea-lion or Sea-bear (*Otaria leonina*), has been observed alive in Europe; so that Dr. Peters's notes could only be derived from the examination of more or less carefully preserved skins; and, I fear, little dependence can be placed on them.

The length, abundance, and, indeed, the presence or absence of the under-fur greatly depend on the season at which the specimen is obtained or observed. It is true that the sealers call some seals hair- and others fur-seals; but that is

only because what they call hair-seals never have more than a very small quantity of under-fur in the fur-season; but, on the other hand, many fur-seals at some seasons have only a small quantity of the under-fur which is so long and abundant at other periods.

The form of the hinder opening of the nostrils, and the form of its front edge, when only one or two skulls of a species were examined, have been regarded as constituting a good character; but when an extensive series of the skulls of a single species or of several species have been examined, that part is found to vary considerably as to the width of its different parts, and especially in the form of the front edge. As far as my observations have extended, the hinder opening of the nostrils appears to become narrower, and especially its front edge, as the animal becomes adult or aged; and in the skulls of the younger specimens it is broader, shorter, and the front edge is broader and more truncated or straight, with only a slight rounding at the sides.

The position of the grinders, as regards the front part of the zygomatic arch, is a good character for the distinction of the species, especially if a series of skulls from animals of different ages, and from the same locality, of each species are compared together; and it is the same with the rooting of the grinders themselves. But when adult skulls of the different species are compared together, the forms of the skulls are so altered, the grinders generally so worn and altered by age, and their position in different species so similar, that the distinction of the species then becomes more difficult.

The Eared Seals (Otariadæ) should certainly form a distinct family from Phocidæ and Trichechidæ, of the suborder Pinnipedia. They are distinguished by the distinct cylindrical conch to the ears, the elongated arms and shins, the feet fringed with a scolloped naked membrane; the fore feet are expanded into the form of a more or less triangular fin, and the hind feet are elongated and narrow. The front toes gradually diminish in size from the inner side; and the hind toes are nearly of equal length, the outer ones on each side being rather the strongest; they are all clawless. The fur in general is provided with a more or less thick under-fur. They walk on the limbs, and rest with the hind part of the body bent down and the legs directed forwards.

The skull and skeleton are as distinct from those of the seal as the external form.

The female lies on her back to receive the caresses of the male; and the young are born on the shore, and then gradually taught to swim.

The genera of the family may be divided into tribes thus :—

Section I. *Palate produced behind to a line even with the condyles of the jaws.* Grinders $\frac{6}{5} \cdot \frac{6}{5}$. Sea-lions.

Tribe 1. OTARIINA.

1. *Otaria.* East and west coast of South America.

Section II. *Palate only extended behind to a line even with the middle part of the zygomatic arch.* Sea-bears.

Tribe 2. CALLORHININA. Grinders $\frac{6}{5} \cdot \frac{6}{5}$. Skull oblong; face broad, shorter than the orbit; forehead arched.

2. *Callorhinus.* North-west coast of America.

Tribe 3. ARCTOCEPHALINA. Grinders $\frac{6}{5} \cdot \frac{6}{5}$; face of the skull shelving in front; the fifth and sixth grinders behind the front of the zygomatic arch.

3. *Phocarctos.* Grinders large, lobed, the six upper with two notches on the hinder edge. South America.
4. *Arctocephalus.* Grinders thick; crown conical. Africa.
5. *Euotaria.* Grinders large, subcylindrical, crown conical; face broad. South America.
6. *Gypsophoca.* Grinders moderate-sized, compressed, with a small, more or less distinct lobe on the front edge of the cingulum; face narrow, compressed. Australia.

Tribe 4. ZALOPHINA. Grinders $\frac{5}{5} \cdot \frac{5}{5}$, large, thick, in a close continuous series; the fifth upper in front of the back edge of the zygomatic arch.

7. *Zalophus.* Grinders large and thick, in a close uniform series. South America.
8. *Neophoca.* Grinders large, thick, all equal, in a continuous uniform series. Australia.

Tribe 5. EUMETOPIINA. Grinders $\frac{5}{5} \cdot \frac{5}{5}$, more or less far apart; the hinder upper behind the hinder edge of the zygomatic arch, and separated from the other grinders by a concave space.

9. *Eumetopias.* West coast of America.
10. *Arctophoca.* West coast of South America.

The skulls of the following species are not known :—

1. *Arctocephalus falklandicus*, Gray, Hamilton, not Peters. New Georgia. B.M.
2. *Arctocephalus nivosus*, Gray (*A. leonina*, var., Murie, Proc. Zool. Soc. 1869, p. 108 ! ! !). Cape of Good Hope. B.M.
3. *Arctocephalus Forsteri*, Fischer (*Phoca ursina*, J. R. Forster). Cloudy Bay, New Zealand. (Ann. & Mag. Nat. Hist. 1868, i. p. 219.) Grinders $\frac{6}{5} \cdot \frac{6}{5}$, conical.

The latter animal is easily known from Dr. J. R. Forster's description and figures.

Phoca nigra, Pallas (Zoog. Rosso-Asiatica; Fischer, Synops. p. 242; Rees, Cyclopædia, *Phoca*), from the Caribbee Islands, is most likely the young of some north-west species of the family.

I cannot agree with Dr. Murie (Proc. Zool. Soc. 1869, p. 108) in regarding *Otaria Philippii* as the same as *O. Hookeri*, but consider it a distinct genus.

XXXI.—*Note on* Anthracosaurus. By ALBANY HANCOCK, F.L.S., and THOS. ATTHEY.

IN the following brief remarks we wish to supply a note to our paper on *Anthracosaurus* and *Urocordylus*, published in the September Number of the 'Annals.' In that paper we described a large portion of the skull of *Anthracosaurus* and a portion of a mandible belonging also to the same Labyrinthodont. We spoke likewise of the occurrence of a central sternal plate, ribs, and vertebræ which we thought belonged to that Amphibian. We are now in a position to show that another considerable fragment of a skull of this interesting Labyrinthodont has occurred in the same locality, the true nature of which fossil, however, has been misunderstood.

In the 'Annals,' some months ago, Mr. T. P. Barkas described what he considered to be a malar bone as large as that of a full-grown crocodile. Having obtained some authentic information respecting this enigmatical bone, we are not surprised to find that it has no resemblance whatever to a reptilian malar, and that it is, in fact, composed of several of the upper cranial bones of the Labyrinthodont alluded to.

Mr. William Dinning, a clever young palæontologist, was allowed by the owner of the fossil in question to make a drawing of it; and he has kindly permitted us to refer to his figure, which represents the specimen of the natural size, and has all the appearance of great accuracy. With the aid of this drawing and the original incomplete description in the 'Annals' there is no difficulty in determining the real nature of this so-called malar. That it is the upper portion of the cranium of a Labyrinthodont, there can be no doubt; neither can there be any doubt that it consists of the two frontals (which are quite distinctly displayed), the parietals, and the greater portion of the supraoccipitals.

We have recently had an opportunity of examining a perfect cranium of a large Labyrinthodont resembling *Loxomma*.

In this specimen the contour of the combined frontals, parietals, and supraoccipitals resembles the general contour of the bones composing the so-called malar in the most remarkable manner; only in this fine cranium they are altogether more elongated in proportion to their width than they are in it; and, besides, in the former the outer margins of the frontals are parallel, or nearly so, while in the so-called malar the frontals considerably widen anteriorly. Now in *Anthracosaurus* this is precisely the case; and though in our specimen of this Labyrinthodont, described in the paper before referred to, the frontals are a little larger than those of the so-called malar, they agree with them exactly in form and proportion. This is sufficiently evident, notwithstanding that they are not quite perfect. Moreover the surface-sculpture of the bone in *Anthracosaurus* is very similar to that represented in Mr. Dinning's drawing; and, indeed, Mr. Dinning says that the surface-sculpture in the two is exactly the same.

We can therefore have little difficulty in concluding that this so-called reptilian malar is really a considerable portion of the upper central bones of the cranium of *Anthracosaurus*. It was found in the same locality that supplied our specimen of this Labyrinthodont, and not very long before it occurred.

XXXII.—*Description of* Ceryle Sharpii, *a new Kingfisher from the Gaboon.* By JOHN GOULD, F.R.S.

I HAVE long had in my collection a specimen of this Kingfisher, which is closely allied to the well-known *Ceryle maxima*, but presents certain striking points of difference. In the first place, it is somewhat smaller, and has the crest almost unspotted and the back entirely so. The principal difference, however, is in the colouring of the abdomen. In *Ceryle maxima* this is white, with a few bars of slaty black on the flanks, while the under tail-coverts are pure white; but in the new species the abdomen and under tail-coverts are slaty black profusely banded with white. Again, the under wing-coverts are thickly banded with black bars, whereas in *C. maxima* they are pure white.

I think there can be no doubt as to the distinctness of the present species, which I propose to call *Ceryle Sharpii*, in honour of Mr. Sharpe, who is now engaged on a monograph of this fine group of birds.

XXXIII.—*On Calamites*. By the Rev. J. W. Dawson, LL.D., F.R.S., &c., Principal of M'Gill College, Montreal.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I have read with much interest, in your Number for August, the translation by Mr. Dallas of the observations of M. Grand'-Eury on Calamites and Asterophyllites. These observations are especially valuable at a time when views as to the structure and affinities of these plants, at variance with those of the best observers on the Continent and in this country, are being propagated under high authority in England.

The observations of M. Grand'Eury in the Coal-measures of the Loire accord perfectly in many important points with those which I have made in the Coal-formation of Nova Scotia, where great numbers of erect Calamites are admirably exposed. The mode of growth of these plants is stated almost in the same terms, and illustrated by figures, in my paper on "Upright Calamites," in the 'Journal of the Geological Society,' vol. vii. (1851) p. 194, and again in my paper on "the South Joggins," in the same Journal, vol. x. (1853) p. 34. My conclusions are shortly summed up in 'Acadian Geology,' second edition, p. 441. There are only two points in which my observations differ from those of M. Grand'Eury. In none of my specimens were there *long* horizontal rhizomes, the secondary stems budding almost directly from the primary. I have not seen a horizontal rhizome longer than a few inches. This, however, is a point of little importance, and might depend on diversity of species or of circumstances. A point of more consequence is that M. Grand'Eury has not seen *leaves* attached to any of his erect stems. I do not wonder at this, because the leaves occur very rarely; and when present, it is often difficult to trace them in the case of erect stems. I have, however, found leaves actually attached to the stems referred by me to three of the species usually recognized, viz. *C. Cistii*, *C. Suckovii*, and *C. nodosus*. In the former they are long and aciculate, in the two latter they are borne in whorls on verticillate branchlets. I have specimens clearly illustrating these facts, and can affirm, on the one hand, that the true Calamites had leaves, at least on some parts of their stems, and, on the other, that these leaves are quite distinct from those which properly belong to the genera *Asterophyllites*, *Annularia*, and *Sphenophyllum*. Beautiful specimens, showing the structure of the stem, enabled me to show, several years ago, that the last-named plants resemble Ferns and Lycopodia, not *Cala-*

mites, in their structure (Journ. Geol. Soc. vol. xxii. p. 135). Some of my specimens illustrating these points were exhibited at the Meeting of the British Association in Glasgow in 1855; but I hope, before the end of the present year, to have the opportunity of demonstrating the facts of the case, by means of actual specimens, in the presence of the Geological Society.

I am, Gentlemen,
Truly yours,
J. W. Dawson.

M'Gill College, Montreal.
Sept. 10, 1869.

XXXIV.—*Note on* Anolis auratus, *Daudin.* By Prof. W. Peters.

Mr. O'Shaughnessy, Senior Assistant in the Natural-History Department of the British Museum, has taken great pains (Ann. & Mag. Nat. Hist. 1869, iii. p. 183) to prove, as he fancies, that I had taken a different species for the true *Anolis auratus*, Daudin, and that I had described the latter as a new species, under the name of *Anolis tropidonotus*. I may be allowed a few words to show that his supposition is not tenable, and that he might have avoided this correction by a little more carefulness.

Daudin (Hist. Nat. Rept. iv. p. 97) says:—"L'anolis doré . . . est parfaitement semblable . . . aux anolis roquet et rayé; *et il ne paroît en différer, que par ses doigts entièrement amincis, même à leur extrémité* et par sa couleur d'un gris doré brillant en dessus, *par une ligne longitudinale blanche*, bordée de brunâtre, *partant de dessous chaque œil et se prolongeant en ligne droite sur chaque flanc jusqu'aux cuisses.*"

Duméril et Bibron (Erpétologie Gén. iv. tableau, pp. 46 et 81) place the genus *Norops* (*Anolis auratus*) together with other genera "*à doigts non-élargis*," in opposition to *Anolis* "*à doigts élargis*," and explain this more accurately by saying, "ce genre semble former le passage entre les trois précédents et celui de *Anolis*, auquel il tient par quelques-unes des espèces chez lesquelles la dilatation des doigts est peu sensible." Respecting the colours, they express themselves (*l.* c. p. 84) in the following manner:—"*L'un offre une raie blanchâtre, qui s'étend depuis l'oreille jusqu'en arrière de l'épaule.*" "Dans notre second individu . . . *à la racine de celle-ci* (*la queue*) *aboutit une raie blanchâtre, qui vient du bord inférieur de l'orbite, en suivant le côté du dos.*" In describing the limbs, they say (p. 88), "Portés en avant, *les membres atteignent*, . . . *ceux de derrière le bord de l'oreille*;" and the excellent figure (pl. 37. fig. 2) shows distinctly a larger occipital plate.

Now the contrary of all this is to be found in the Mexican *A. tropidonotus*, which has the toes *distinctly dilated*, *never a white stripe on the side*, *no larger occipital shield*, and the hinder limbs longer, reaching beyond the head or to the nasal aperture (*not ear-opening*, as Mr. O'Shaughnessy *thinks*).

Of course, by *supposing*, as Mr. O'Shaughnessy does suppose, that Duméril and Bibron's description of the length of the limbs is incorrect, and their (with regard to the details) very excellent figure erroneous (composed of two different species), and by *suppressing*, as Mr. O'Shaughnessy does suppress, Daudin and Duméril's notice about the characteristic white lateral marking, it will be easy to transmute also every other species of *Anolis* into a *Norops auratus*.

It is well known that the length of the tail in slender-tailed lizards varies very much according to the individuals, which, besides, do not always arrive in a perfectly natural state, and that it therefore is not to be considered a very important character for distinguishing species. I have to add that I have lately examined specimens of *A. auratus*, Daudin, which had an imperfect or perfect *second* series of large scales between the supralabials and the eye; but this second series is not constant, and consists of narrower scales between the supralabials and the constant scales of the upper row. The dilatation of the toes in *A. auratus* is not absent, but hardly visible.

Finally, I have to remark that I have examined the type specimens of *Norops auratus*, Dum. & Bibr., at Paris, others at Leyden, the *Norops auratus*, Wagler, at Munich, and the *Anolis 12-striatus*, Berthold, at Göttingen, all of which belong to the same species, found only in the northern parts of South America.

XXXV.—*On* Norops auratus. By Arthur W. E. O'Shaughnessy.

Prof. Peters has kindly communicated the above to me before sending it for insertion.

As he calls in question my *carefulness*, in endeavouring to refute the view I put forward in the March Number of the 'Annals' of the present year, respecting the species of *Norops*, I would ask permission to say a few words in reply to him. Daudin's description must, as I said before, be regarded as of generic rather than specific value; it is his merit to have distinguished a *Norops* from an *Anolis* by means of that character of "doigts amincis" which Prof. Peters quotes above. As to the toes being "entièrement amincis," it is clear that,

in the words of Dr. Hallowell, one species (*N. auratus*) has the toes "dilated, although not to the same extent as in many species of *Anolis*," while in the other species (his *macrodactylus*, which is the 12-*striatus*) they are "totally destitute of such dilatation." Daudin, however, gives no description of other characters sufficient to establish one or other of the species; the coloration which he describes might be that of 12-*striatus*, were it not for the two different descriptions of coloration given by Duméril and Bibron in their more elaborate account of *Norops auratus*. In their *résumé* of the characters of that species I read, "Corps d'un brun fauve doré, avec ou sans bande d'une teinte plus claire sur le dos," with no mention whatever of a white stripe; and in their coloured figure there is only a partial one from the ear to the shoulder, whereas the dark purplish stripe which I have mentioned as occurring in *auratus* extends unaccompanied the whole length of the side. It was the subsequent statement about a white lateral stripe in one of the specimens, together with the length given to the hind legs, which led me to presume that one of their specimens might have been a *N.* 12-*striatus*. As, however, in all other respects their description differs from that of *N.* 12-*striatus*, justifying Dr. Berthold's subsequent separation of that species, and as it is the first satisfactory scientific description of *N. auratus*, I think it but natural to take it as the basis of all argument relative to that species.

Since Duméril and Bibron have given two descriptions of the coloration, I have, of course, as much right to choose the one in support of my view as Prof. Peters has to choose the other. My "supposition" of the identity of his *Anolis tropidonotus* with the species of Duméril and Bibron does not, however, rest merely or even chiefly on the matter of the coloration, but on the fact of the agreement of the two in *all* the important characters which are more properly structural, save the one above mentioned. With regard to *this*, I need only quote Dr. Berthold's express statement that the hind limbs in *N. auratus* of Daudin, Wagler, and Duméril and Bibron "reach to the mouth, the fore limbs even beyond;" and I may state, besides, that in a specimen of that species which I have just examined both pairs of limbs reach beyond the head (as in *tropidonotus*). What can be plainer than these words of Prof. Peters,—"*Two* longitudinal rows of keeled scales between the supralabials and the eye" (in *tropidonotus*)? or than these of Duméril and Bibron,—"Il existe un *double rang* de grandes écailles carénées au-dessus de la série des plaques labiales supérieures"?

Curiously enough, in the latter part of his note, Prof. Peters

furnishes me with yet further confirmation by stating that he has lately observed a *second* "imperfect or perfect series of larger scales between the supralabials and the eye" in *A. auratus*.

Then, again, he expressly says that the tail in his species is even shorter than it is described to be by Duméril and Bibron.

Also "the expansion of the toes is more developed." We have already seen how explicit Dr. Hallowell has been on this point; and he states, what is important, that his specimen of *N. auratus* was received from the Garden of Plants, at Paris. Prof. Peters himself has confessed that his species is probably the same as this one mentioned by Dr. Hallowell, and that it was determined as *N. auratus* from a comparison with specimens in the Paris Museum. In the specimen of *N. auratus* which I am now examining, the occipital plate is very small, much smaller than the surrounding scales, just as it is said to be in *A. tropidonotus*. Duméril and Bibron say the scales "qui occupent . . . l'occiput offrent un peu moins de longueur," but do not mention a large occipital plate.

When the specimen is not obviously immature, and the tail not damaged in any way, its comparative length should at least not be overlooked, as all the descriptions, including that of Prof. Peters, make it a particular point.

Now *N. 12-striatus* is a slenderer lizard, with head more depressed and pointed, the scales of the *muzzle only* keeled, those of the rest of the head being smooth (the head is entirely covered with keeled scales in *auratus*; see D. & B.); tail thrice the length of the body; toes not dilated, much shorter limbs, and only one series of scales between the supralabials and the eye. And if these differences are not to be held sufficient in Dr. Berthold's hands to establish his species, what, I would ask, is there in Prof. Peters's description of *tropidonotus* to warrant him in separating that form from *N. auratus?* Consequently, unless Prof. Peters prefers to take the mere colour-description of Daudin, and set aside altogether that of Duméril and Bibron, he cannot successfully maintain that his *A. tropidonotus* is different from *Norops auratus*, or that the *12-striatus* of Berthold is identical with it. But if he considers Daudin's description sufficient to characterize one or other of the species, and would insist upon the species so characterized being the same as that of Duméril and Bibron, then, more than ever, is his *Anolis tropidonotus* a *Norops auratus*, since all the other characters enumerated by those writers must be attributed to the species of Daudin.

Although I have not observed any trace of a white stripe in *Norops auratus*, yet there may perhaps sometimes be a

partial one, as represented in the coloured figure which shows the black or purplish stripe of that species.

As I stated before, Dr. Hallowell says that his specimen of *N. auratus* (the one received from Paris) was from Mexico. I would add that I have lately had an opportunity of examining two more specimens of *Norops duodecimstriatus*, and that they agree well with Dr. Berthold's description.

BIBLIOGRAPHICAL NOTICES.

A History of British Hydroid Zoophytes. By Thomas Hincks, B.A. 2 vols. Van Voorst, 1869.

We regret that circumstances have prevented our before noticing this valuable work, which has now been out some months. It is a long looked-for addition to our zoological literature, and it comes to us as a welcome guest. Mr. Hincks has for many years laboured patiently and assiduously in the study of that order of animals formerly associated with organisms belonging to wholly different types, under the general term Zoophytes, but now considered to constitute one of three orders included in the class Hydrozoa of Huxley, and known as Hydroida. A work upon this subject was very greatly needed. Two classes of the animals embraced in Johnston's 'Zoophytes' had already been ably handled in more recent publications—the Polyzoa by Mr. Busk*, and the Actinozoa by Mr. Gosse†. Meanwhile, however, the class Hydrozoa has remained untreated of. Wonderful strides were being made in our knowledge of the affinities, structure, and marvellous life-history of its members. The discovery of the so-called "alternation of generations," of the sexual differentiation of many species, and of the peculiarities and diversity in the mode of reproduction and evolution of the several families and genera, have thrown over the study and investigation of this order of animals a flood of interest which is perhaps scarcely equalled, and certainly not surpassed, in any other group of the animal kingdom. During the last twenty years a host of able naturalists have been adding their contributions to the common store of knowledge of these animals. Sars, Ehrenberg, Krohn, Agassiz (father and son), Lovén, Huxley, Alder, Hincks, Van Beneden, Allman, Kölliker, Steenstrup, Dujardin, Gegenbaur, Leuckart, Strethill Wright, Clark, Greene, Claparède, &c. have been among the most active investigators who, in all parts of the world, have been patiently working out those detailed facts upon which alone the generalisations of a true systematic arrangement can be based.

'The History of British Hydroid Zoophytes' opens with an In-

* Catalogue of the Marine Polyzoa in the Collection of the British Museum. By George Busk, F.R.S. 1852–54.

† A History of the British Sea-Anemones and Corals. By P. H. Gosse, F.R.S. Van Voorst, 1860.

troduction of seventy-eight pages. We must confess to great disappointment with this portion of the work. We had hoped to find here a careful analysis of all that is now known of the reproduction, development, and affinities of these animals, given in such a way as to arouse at once the incipient naturalist's interest and stimulate him not so much to the collection of specimens as to the observation of facts and the history of species. Instead of this, we find only a short account of the physiology, general morphology, and reproduction, condensed into the briefest possible space—so much so as to be nearly unintelligible to those not previously acquainted with the subject, and repellent from its laconic brevity. This is much to be regretted. An attempt to describe the reproduction of the Hydroida in such a work as this in the short space of twenty pages is an attempt at an impossibility.

When we pass, however, from the introduction to the descriptive portion of the work, we find everything to merit praise. It is in this that the value of the book consists. It has for some time been hopeless for any beginner to attempt the study of the smaller Hydroida; the work of Johnston was so greatly behind the day, and the number of species since described by Alder, Allman, Hincks, Strethill Wright, Norman, Hodge, &c. so great, that, scattered as they were throughout all sorts of publications, some illustrated and some not, it would have been a hopeless task for any naturalist who had not gradually kept pace with the subject to commence *de novo* its study. It is therefore with no little interest we take up these volumes, in which all the species that have been described are brought together, carefully defined, and fully illustrated.

Mr. Hincks distributes the Hydroida into three suborders, which he names Athecata, Thecaphora, and Gymnochroa—names which correspond with, but are certainly preferable to, the Tubularina, Sertularina, and Hydrina of Ehrenberg as adopted by Johnston, and with the orders Hydridæ, Corynidæ, and Sertularidæ of Greene, the last being objectionable, not only because, as the former, they are derivatives from the names of genera, but doubly so as having the termination *-idæ*, which is always considered to be indicative of families, and not of orders. These suborders contain one hundred and seventy-nine species, of which sixty-one only are to be found in the 'History' of Dr. Johnston. The chief discoveries have been among the Athecata, as will be evident from the following table, and are for the most part very small forms:—

	Hincks.	Johnston.
Athecata	72	14
Thecaphora	93	43
Gymnochroa	4	4

The descriptions of both genera and species are very carefully drawn up, and are full without being diffuse. Dichotomous tables are given at p. 51 of the Introduction; these are always very useful, and will at once enable the student to refer any species which he may find to its place.

Numerous woodcuts are interspersed throughout the text; and the second volume is entirely occupied with sixty-seven plates of the species, from drawings by the author and his friends, and engraved by Tuffen West. The plates are excellent; almost every species is fully illustrated, and the character of the drawings is all that could be wished.

British Conchology. Vol. V. By John Gwyn Jeffreys, F.R.S., F.G.S., &c. Van Voorst, 1869.

Mr. Jeffreys's work upon the British Mollusca is complete. We have from time to time noticed the previous volumes as they were published, and are glad to welcome the fifth and concluding volume. We believe that the work has extended to a much greater length than was originally contemplated by its author; but at the same time it is much more complete. While we regret that this very perfection of the book, and its consequently increased price, places it, we fear, beyond the reach of many active naturalists, the length of whose purse is not in proportion to their ardour in the pursuit of natural history, it will be a satisfaction to all students of conchology who can purchase Mr. Jeffreys's work to find that it supplies them with all that they could desire. There is very much here which is not to be met with in the 'History' of Forbes and Hanley—descriptions and figures of the numerous species which have been recently added to the British fauna, descriptions of a large number of the inhabitants of the shells which are not to be found elsewhere, numerous corrections of synonymy, much extended information on the range in area, in depth, and in geological time of the species, together with a mass of carefully analyzed and compressed details on life-history and habits, collected from the extended bibliography on the subject of the last twenty years.

The present volume contains the history of the families Aplysiadæ, Pleurobranchidæ, Runcinidæ, and Pleurophyllidiidæ; the order Nudibranchiata, the marine Pulmonobranchiata, and the classes Cephalopoda and Pteropoda. The account of the Nudibranchiate Mollusca was written for Mr. Jeffreys by the late Mr. Alder, and therefore has additional value as coming from him who was *facile princeps* in that department of the Mollusca. At the end of the volume is a supplement containing some eighty pages of very condensed notes of recent observations on an immense number of species, and descriptions of many Mollusca new to the British fauna, the products chiefly of Shetland dredging, and of the dredging of Messrs. Carpenter and Thomson last year, in H.M.S. 'Lightning,' in the abyss of the sea between the Hebrides and Faroe Islands. These notes are of extreme interest, showing the range of a considerable number of Mollusca to the great depth of from 500 to 650 fathoms.

But the chief value of this concluding volume of 'British Conchology' consists in the plates. At the commencement we find, as usual, a coloured frontispiece—in this instance an admirably coloured and life-like figure of *Octopus vulgaris*, one of the very best and

most natural illustrations of a Cephalopod that we have seen; and at the end of the volume are eight plates illustrating the genera described here, and of similar character to the plates of the preceding volumes. But besides those, there are *one hundred and two 'Supplemental Plates,'* containing figures of all the species of shells (and of some of the more marked varieties) described in the entire work, which is thus completely illustrated. These plates supply what was felt to be greatly needed in the earlier volumes, and Mr. Jeffreys's work must now become the standard authority on the Mollusca of the north of Europe. The figures, upon the whole, are good, certainly better than could have reasonably been expected for the small sum at which the volume is procurable; but we could have wished that Mr. Sowerby had bestowed more care upon some of the closely allied and less easily discriminated smaller shells, and especially that the plan of giving a single whorl more highly magnified had been more extensively carried out. The experienced conchologist will be glad to find in these plates illustrations of the recent additions to the British fauna in engravings of seventy-eight shells which are not to be found in the older authority, Forbes and Hanley.

Below we give, as in the previous notices, a concise summary of the Mollusca introduced to us in vol. v. which are recent acquisitions to the fauna of our islands:—

Aplysia depilans, Linné. Guernsey (*Gallienne*).
Eolis cærulea, Montagu. Weymouth (*Thompson*); Salcombe Bay (*Hincks*).
E. Adelaïdæ, Thompson. Weymouth (*Thompson*) (=*E. Robertianæ*, M'Intosh, St. Andrews).
Doto cuspidata, A. & H. Shetland (*Jeffreys & Waller*).
Hero formosa, Lovén. Northumberland (*G. S. Brady*); Firth of Clyde (*D. Robertson*); Minch, off Loch Carron (*J. G. J.*).
Lomonotus Portlandicus, Thompson. Weymouth Bay (*Thompson*).
Crimora capillata, A. & H. Guernsey (*Norman*).
Doris Lovéni, A. & H. Bantry Bay (*Norman*).
Clio pyramidata, Browne. Shetland (*J. G. J.*).
Rossia papillifera, Jeffreys. North of Shetland, 60–100 fathoms (*J. G. J.*).

In the Supplement we find the following, either now first added to the British fauna, or forms which had been regarded as varieties in the body of the work, but are here reinstated as of specific rank. The latter we have indicated by brackets, to distinguish them from the true novelties:—

[*Arion flavus*, Müller.]
[*Limax lævis*, Müller=*L. brunneus*, Bouch.-Chant.]
[*L. tenellus*, Müller.]
Clausilia parvula, Studer. Kinver, near Stourbridge (*G. Allen*).
C. solida, Draparnaud. Stapleton, near Bristol (*Rich*).
Terebratella Spitzbergensis, Davidson. A fresh and perfect spe-

cimen, in 90–100 fathoms, 35 miles N.N.W. of Unst; possibly a relic of the glacial period.

Pecten aratus, Gmelin. North of Hebrides, 350 fathoms (*Carpenter & Thomson*).

P. vitreus, Chemnitz. Shetland; a small valve in a mass of *Lophohelia prolifera* (*Dr. Edmonston*); North of Hebrides, 189 and 650 fathoms (*Carpenter & Thomson*).

Leda lucida, Lovén. North of Hebrides, 189–650 fathoms (*Carpenter & Thomson*).

Limopsis borealis, Woodward, MS. A small single valve, with *L. aurita*, in 189 fathoms, about 50 miles north of the Hebrides (*Carpenter & Thomson*).

Arca nodulosa, Müller. Orkneys; a single valve (*Capt. Thomas*); north of Hebrides, 189–530 fathoms (*Carpenter & Thomson*).

Montacuta tumidula, Jeffreys. Hebrides and Shetland, 40–80 fathoms, on muddy ground, rare (*J. G. J.*).

M. Dawsoni, Jeffreys. Off Cruden, Moray Firth (*Dawson*).

M. donacina, S. Wood. A valve in St. Magnus Bay, Shetland (*J. G. J.*).

Kellia cycladia, S. Wood. A few living specimens and a single dead valve, recently procured off Shetland, in 60–90 fathoms (*J. G. J.*).

Cypricardia lithophagella, Lamarck. Single valve in dredged sand from Guernsey (*Waller*).

Siphonodentalium Lofotense, Sars. Muddy sand in 40–140 fathoms, among the Hebrides and Shetland Isles (*J. G. J.*).

Cadulus subfusiformis, Sars. Fine sand near Unst, in 85–140 fathoms, local, but not uncommon (*J. G. J.*); north of Hebrides, 170 and 189 fathoms (*Carpenter & Thomson*).

Dentalium abyssorum, Sars. Shetland, 78 and 82 fathoms, two young but living specimens; north of Hebrides, 189 and 650 fathoms (*Carpenter & Thomson*).

Trochus glaucus, Moller. Dredged by Mr. M'Andrew in about 20–30 fathoms, between Kyleakin and Kyle Rhea, in Skye.

Lacuna tenella, Jeffreys. North of Hebrides, 189 and 650 fathoms (*Carpenter & Thomson*).

Natica affinis, Gmelin. North of Hebrides, 189 fathoms (*Carpenter & Thomson*).

[*Odostomia Warreni*, Thompson.]

Pleurotoma carinata, Bivona. N.N.W. of Unst, pebbly ground, 120 fathoms, one living and one dead specimen (*J. G. J.*); north of Hebrides, 189 fathoms (*Carpenter & Thomson*).

Utriculus globosus, Lovén. St. Magnus Bay, 60–80 fathoms, on a muddy bottom, very rare (*J. G. J.*).

Scaphander librarius, Lovén. North of Hebrides, 530 fathoms (*Carpenter & Thomson*).

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 17, 1869.—Lieut.-General Sabine, President, in the Chair.

"On some Elementary Principles in Animal Mechanics."—No. II. By the Rev. SAMUEL HAUGHTON, M.D. Dublin, D.C.L. Oxon., Fellow of Trinity College, Dublin.

In a former communication to the Royal Society on this subject (Annals, October 1867, p. 294), I endeavoured to establish the two following principles:—

I. *That the force of a muscle is proportional to the area of its cross section.*

II. *That the force of a muscle is proportional to the cross section of the tendon that conveys its influence to a distant point.*

The first of these principles is true under all circumstances; but the second requires to be modified somewhat in its statement. If the conditions as to friction of the tendons that convey the action of the muscles to a distant point be the same, then the force of the muscles will be proportional to the cross sections of the tendons; but if the tendons be subjected to different amounts of friction, then the areas of their cross sections will cease to be proportional to the forces of the muscles as represented by the areas of their cross sections.

In my former paper (No. I.), I selected, in illustration of principle II., the long flexor tendons of the toes of the Rhea and other struthious birds, and showed that the cross sections of the muscles and tendons bore, approximately, a constant ratio to each other. Now, in the *Struthionidæ* the conditions as to friction of the long flexor tendons of the toes are similar, although different in each species; and hence it was easy to prove that the ratios of the cross sections of the muscles and tendons were nearly constant.

When, however, muscles and tendons, variously conditioned as to friction, are compared together, the constancy of the ratio of their cross sections disappears, and undergoes a variation depending on the friction to which both muscles and tendons are exposed.

In order to ascertain the proportion of the cross section (or force) of a muscle to the cross section (or strength) of its tendon in the human subject, I made the following observations on the right arm and hand of a well-developed male subject in the Royal College of Surgeons in Ireland, in March 1868.

I first ascertained the specific gravities of the muscles and tendons, with the following results:—

Muscles.

Biceps humeri (*long head*)	1·05
Biceps humeri	1·054
Brachialis	1·053
Mean	1·0523

Tendons.

Scapular tendon of biceps	1·112
Radial tendon of biceps	1·119
Mean............	1·1155

From these specific gravities it was easy to determine the cross section of either muscles or tendons, by weighing a known length of either one or the other. In this manner the following Table was constructed:—

Cross sections of Muscles and Tendons in an Adult Human Male Subject, and Ratios of the same.

Name of muscle.	Cross section of muscle, in square inches.	Cross section of tendon, in square inches.	Ratio of cross section of muscle to that of tendon.
1. Biceps humeri	0·895	0·0317	28·2
2. Palmaris longus	0·148	0·0050	26·4
3. Ext. carp. rad. longior ...	0·584	0·0223	26·2
4. Ext. carp. rad. brevior ..	0·405	0·0220	18·4
5. Biceps humeri (long head)	0·379	0·0212	18·0
6. Fl. poll. longus	0·228	0·0145	15·7
7. Fl. carp. rad.	0·234	0·0155	15·1
8. Ext. carp. uln..............	0·212	0·0199	10·7
9. Fl. dig. subl.	0·618	0·0665	9·3
10. Fl. dig. prof.	0·768	0·0928	8·3
11. Ext. oss. met. poll.	0·223	0·0289	7·7
12. Fl. carp. uln.	0·182	0·0254	7·2

From the preceding Table, it appears that the ratio of the cross section of the muscles to that of the tendons may range from 7 to 28, or be four times as great in one case as in another. We may also see in general, that the tendons exposed to the greatest amount of friction have the smallest coefficients of cross section. Thus the radial tendon of the *biceps* has a coefficient of 28·2, while the scapular tendon, which undergoes the friction of passing over the head of the humerus, has a coefficient of 18·0. Again, the *Ext. oss. met. poll.*, whose tendon winds round the radius, and has the duty imposed upon it of binding down the tendons of the radial extensors of the wrist, has the coefficient of 7·7, as compared with 26·2 and 18·4, the coefficients of the comparatively free tendons of these extensors.

As it might be objected that the relative cross sections of muscle and tendon, in a human subject that died a natural death, might be exceptional in character, from wasting during the last illness, I determined to test the question by experiment, and accordingly selected a fine Pyrenean Mastiff for the purpose, which I killed by strychnia, and dissected immediately after death, with the following results, which were obtained, as before, by noting the specific gravities of the muscles and tendons, and by weighing a measured length of each:—

Cross sections of Muscles and Tendons in a Pyrenean Mastiff, and ratios of the same.

Name of muscle.	Cross section of muscle, in square inches.	Cross section of tendon, in square inches.	Ratio of cross section of muscle to that of tendon.
1. Gastrocnemius	2·631	0·0520	50·6
2. Fl. carp. rad.	0·283	0·0059	48·0
3. Fl. dig. long.	0·195	0·0045	43·3
4. Ext. carp. rad....	0·632	0·0160	39·5
5. Fl. carp. uln.	0·176	0·0056	31·4
6. Fl. hall. long.	0·680	0·0228	29·8
7. Biceps humeri...............	0·909	0·0449	20·2
8. Fl. dig. subl.	0·319	0·0251	12·7
9. Fl. dig. prof	0·902	0·0830	10·9
10. Ext. carp. uln	0·181	0·0197	9·2

These results, obtained from measurements made upon a freshly killed animal, confirm those found from observation of the human subject, and prove that the ratio of the cross section of the muscle to that of its tendon depends upon the amount of friction experienced by the latter, the coefficient being greater in proportion as the friction is less.

The following observations, made upon a Wallaby Kangaroo, confirm in a general way the preceding results:—

Cross sections of Muscles and Tendons in a Wallaby Kangaroo, and ratios of the same.

Name of muscle.	Cross section of muscle, in square inches.	Cross section of tendon, in square inches.	Ratio of cross section of muscle to that of tendon.
1. Gastrocnemius..............	1·313	0.0356	36·9
2. Fl. long. dig.	0·354	0·0246	14·4

It appears from the preceding investigation that the cross section of a muscle does not bear a constant ratio to the cross section of its tendon, unless the friction experienced by the muscle and tendon be also constant, and that there may even be a *surplusage* of strength in the tendon beyond what is absolutely necessary to resist the combined force of the muscle and friction. This surplusage, however, cannot be supposed to be large, if the principle of *economy of material* in nature be admitted.

"On *Holtenia*, a Genus of Vitreous Sponges." By Wyville Thomson, LL.D., F.R.S., Professor of Natural Science in Queen's College, Belfast.

During the deep-sea dredging cruise of H.M.S. 'Lightning' in the autumn of the year 1868, the dredge brought up, on the 6th of September, from a depth of 530 fathoms, in lat. 59° 36′ N., and

long. 7° 20′ W., about 20 miles beyond the 100-fathom line of the Coast-Survey of Scotland, fine, grey, oozy mud, with forty or fifty entire examples of several species of siliceous sponges. The minimum temperature indicated by several registering thermometers was 47°·3 F., the surface-temperature for the several localities being 52°·5 F.

The mud brought up consisted chiefly of minute amorphous particles of carbonate of lime, with a considerable proportion of living *Globigerinæ* and other Foraminifera, and of the "coccoliths" and "coccospheres" so characteristic of the chalk-mud of the warmer area of the Atlantic. The sponges belonged to four genera: one of these was the genus *Hyalonema*, previously represented by the singular glass-rope sponges of Japan and the coast of Portugal; and the other three genera were new to science. One of these latter was the subject of the paper.

Associated with the sponges were representatives, usually of a small size, of the Mollusca, the Crustacea and Annelides, the Echinodermata, and the Cœlenterata, with numerous large and remarkable rhizopods. Many of the higher invertebrates were brightly coloured and had eyes.

Four nearly perfect specimens of the sponge described in the memoir were procured.

HOLTENIA, n. g.*

H. CARPENTERI, n. sp.

The body of the sponge is nearly globular or oval. Normal and apparently full-grown specimens are from 9″ to 1′ 1″ in length, and from 7″ to 9″ wide. The outer wall consists of an open, somewhat irregular, but very elegant network, whose skeleton is made up of large separate siliceous spicules. These spicules are formed on the sexradiate stellate type; but usually only five rays are developed, the sixth ray being represented by a tubercle. To form the framework of the external wall, the four secondary branches of the spicule spread on one plane, the surface of the sponge, while the fifth or azygous branch dips down into the sponge-substance. This arrangement of the spicules gives the outer surface of the sponge a distinctly stellate appearance, the centres of the stars being the point of radiation of the secondary branches of the spicules. These quinqueradiate spicules measure about 1″ 5‴ from point to point of the cross-like secondary branches; and the length of the azygous arm is from 7·5‴ to 1″.

Smaller stars, formed by the radiation of smaller spicules of the same class, occupy the spaces between the rays of the larger stars.

The rays of each star bend irregularly, and meet the rays of the spicules forming the neighbouring stars. The rays of the different spicules thus run along for some distance parallel to one another,

* The genus is named in compliment to M. Holten, Governor of the Faroe Islands; and the species is dedicated to Dr. W. B. Carpenter, V.P.R.S., with whom the author was associated in the conduct of the expedition. [A figure of the species is given at p. 120 of the present volume of the 'Annals.']

and are held together by a layer of elastic sarcode, which invests all the spicules and all their branches. Between the rays of the spicules, over the whole surface, the sarcode forms an ultimate and very delicate network, its meshes defining minute inhalant pores.

At the top of the sponge there is a large osculum, about 3″ in diameter, which terminates a cylindrical cavity, which passes down vertically into the substance of the sponge to a depth of 5″ 5‴. The walls of this oscular cavity are formed upon the same plan as the external wall of the sponge; and the stars, which are even more conspicuous than those of the outer wall, are due to the same arrangement of spicules of the same form. The ultimate sarcode network is absent between the rays of the stars of the oscular surface.

The sponge-substance, which is about 2″ in thickness between the oscular and the outer walls, is formed of a loose vacuolated arrangement of bands and rods of greyish consistent sarcode, containing minute disseminated granules and groups of granules of horny matter, and minute endoplasts.

Towards the outer wall of the sponge the sarcode trabeculæ are arranged more symmetrically, and at length they resolve themselves into distinct columns, which abut against and support the centres of the stars, leaving wide, open, anastomosing channels between them. The sarcode of the outer wall, and that of the wall of the oscular cavity, is loaded with minute spicules of two principal forms—quinqueradiate spicules with one ray prolonged and feathered, and minute amphidisci.

Over the lower third of the body of the sponge, fascicles of enormously long delicate siliceous spicules pass out from the sarcode columns of the sponge-body in which they originate, through the outer wall, to be diffused to a distance of not less than half a metre in the mud in which the sponge lives buried; and round the osculum and over the upper third of the sponge, sheaves of shorter and more rigid spicules project, forming a kind of fringe.

The author referred all the sponges which were found inhabiting the chalk-mud to the Order Porifera Vitrea, which he had defined in the 'Annals and Magazine of Natural History' for February 1868. This order is mainly characterized by the great variety and complexity of form of the spicules, which may apparently, with scarcely an exception, be referred to the sexradiate stellate type, a form of spicule which does not appear to occur in any other order of sponges. The genus *Holtenia* is nearly allied to *Hyalonema*, and seems to resemble it in its mode of occurrence. Both genera live imbedded in the soft upper layer of the chalk-mud, in which they are supported,—*Holtenia* by a delicate maze of siliceous fibres, which spread round it in all directions, increasing its surface without materially increasing its weight—*Hyalonema* by a more consistent coil of spicules, which penetrates the mud vertically and anchors itself in a firmer layer.

It appeared to the author and to Dr. Carpenter, who had had their attention specially directed to this point as bearing upon the continuity and identity of some portions of the present calcareous

deposits of the Atlantic with the Cretaceous formation, that the vitreous sponges are more nearly allied to the *Ventriculites* of the chalk than to any recent order of Porifera. They are inclined to ascribe the absence of silica in many Ventriculites, and the absence of disseminated silica in the chalk generally, to some process, probably dialytic, subsequent to the deposit of the chalk, by which the silica has been removed and aggregated in amorphous masses, the chalk flints.

The Vitreous Sponges, along with the living Rhizopods and other Protozoa which enter largely into the composition of the upper layer of the chalk-mud, appear to be nourished by the absorption through the external surface of their bodies of the assimilable organic matter which exists in appreciable quantity in all sea-water, and which is derived from the life and death of marine animals and plants, and, in large quantity, from the water of tropical rivers. One principal function of this vast sheet of the lowest type of animal life, which probably extends over the whole of the warmer regions of the sea, may be to diminish the loss of organic matter by gradual decomposition, and to aid in maintaining in the ocean the "balance of organic nature."

"On *Palæocoryne*, a Genus of Tubularine Hydrozoa from the Carboniferous Formation." By Dr. P. MARTIN DUNCAN, F.R.S., Sec. Geol. Soc., and H. M. JENKINS, Esq., F.G.S.

Palæocoryne is a new genus containing two species, and belongs to a new family of the Tubularidæ. The forms described were discovered in the lower shales of the Ayrshire and Lanarkshire coalfield; and an examination of their structure determined them to belong to the Hydrozoa, and to be parasitic upon Fenestellæ. The genus has some characters in common with *Bimeria* (St. Wright), and the polypary is hard and ornamented. The discovery of the trophosome and probably part of the gonosome of a tubularine Hydrozoon in the Palæozoic strata brings the order into geological relation with the doubtful Sertularian Graptolites of the Silurian formation, and with the rare medusoids of the Solenhofen stone.

"On the Rhizopodal Fauna of the Deep Sea." By WILLIAM B. CARPENTER, M.D., V.P.R.S.

The author commences by referring to the knowledge of the Rhizopodal fauna of the Deep Sea which has been gradually acquired by the examination of specimens of the bottom brought up by the sounding-apparatus; and states that whilst this method of investigation has made known the vast extent and diffusion of Foraminiferal life at great depths—especially in the case of *Globigerina-mud*, which has been proved to cover a large part of the bottom of the North Atlantic Ocean—it has not added any new generic types to those discoverable in comparatively shallow waters. With the exception of a few forms, which, like *Globigerina*, find their most

congenial home, and attain their greatest development, at great depths, the general rule has seemed to be that *Foraminifera* are progressively dwarfed in proportion to increase of depth, as they are by a change from a warmer to a colder climate—those which are brought up from great depths in the Equatorial region bearing a much stronger resemblance to those of the colder temperate, or even of the Arctic seas, than to the littoral forms of their own region.

The author then refers to the recent researches of Prof. Huxley upon the indefinite protoplasmic expansion which he names *Bathybius*, and which seems to extend itself over the ocean-bottom under great varieties of depth and temperature, as among the most important of the results obtained by the sounding-apparatus.

By the recent extension of dredging-operations, however, to depths previously considered beyond their reach, very important additions have been made to the Foraminiferal fauna of the Deep Sea. Several new generic types have been discovered, and new and remarkable varieties of types previously known have presented themselves. It is not a little curious that all the *new* types belong to the Family Lituolida (consisting of Foraminifera which do not form a calcareous shell, but construct a "test" by the agglutination of sand-grains), which was first constituted as a distinct group in the author's 'Introduction to the Study of the Foraminifera' (1862). The first set of specimens described seem referable to the genus *Proteonina* of Prof. Williamson; but the test, instead of being composed (as in his specimens) of sand-grains, is constructed of sponge-spicules, cemented together with great regularity, so as to form tubes, which are either fusiform or cylindrical, being in the former case usually more or less curved, and in the latter generally straight. Of the genus *Trochammina* (Parker and Jones) many examples were found of considerable size, resembling Nodosarians in their free moniliform growth, but having their tests constructed of sand-grains very firmly cemented together, with an intermixture of fragments of sponge-spicules, which give a hispid character to the surface.—The genus *Rhabdammina* of Prof. Sars is based on a species (the *R. abyssorum*) first obtained in his son's dredgings, of which the test is very regularly triradiate, sometimes quadriradiate, and is composed of sand-grains very regularly arranged, and firmly united by a ferruginous cement. Not only was this type represented by numerous specimens in the 'Lightning' dredgings, but another yet more considerable collection was formed of irregularly radiating and branching tubes, which are composed of an admixture of sand-grains and sponge-spicules, united by ferruginous cement. These seem to originate in a "primordial chamber" of the same material, which extends itself into a tube that afterwards branches indefinitely. This type may be designated *R. irregularis*.—Of the protean genus *Lituola* (Lamarck) a large form was met with which bears a strong resemblance to the *L. Soldani* of the Sienna Tertiaries. Its nearly cylindrical test is composed of sand-grains very loosely aggregated together, forming a thick wall; and its cavity is divided by septa of the same material into a succession of chambers, arranged in

rectilineal series, each having a central orifice prolonged into a short tube. The genus *Astrorhiza*, instituted a few years ago by Dr. O. Sandahl, was represented by a wide range of forms, referable to two principal types (the one an oblate spheroid, with irregular radiating prolongations, the other more resembling a stag's horn, with numerous digitations), passing into one another by insensible gradations. The composition of its thick arenaceous test is exactly the same as that of the test of the *Lituola* found on the same bottom; but its cavity is undivided; and there is no proper orifice, the pseudopodial extensions having apparently found their way out between the sand-grains that formed the termination of the radiating extensions or digitations. The genus *Saccammina* (Sars) is characterized by a very regular spherical test, built up of large angular sand-grains strongly united by ferruginous cement, which are so arranged as to form a wall-surface well smoothed off externally, whilst its interior is roughened by their angular projections. The cavity is undivided, and is furnished with a single orifice, which is surrounded by a tubular prolongation of the test, giving to the whole the aspect of a globular flask.

The family Miliolida, consisting of porcellanous-shelled Foraminifera, was represented at the depth of 530 fathoms by a *Cornuspira foliacea* of extraordinary size, and at the depth of 650 fathoms by a series of *Biloculinæ* of dimensions not elsewhere seen except in tropical or subtropical regions.

Of the family Globigerinida a considerable number of forms presented themselves; but, with the exception of the ordinary *Globigerina* and *Orbulina*, these were not remarkable either for number or size. The *Globigerina*-mud brought up in large masses by the Dredge, exhibited the same composition as had been previously determined by the examination of Soundings; but it included a large amount of animal life of higher types, whilst it seemed everywhere permeated by the protoplasmic *Bathybius* of Huxley, as described in the author's "Preliminary Report." The *Globigerinæ* vary enormously in size; and the author gives reason for the belief that this variation is not altogether the result of growth, but that many small as well as large individuals have (speaking generally) attained their full dimensions. He describes the sarcodic body obtained by the decalcification of the shell, and discusses the question whether (as some suppose) *Orbulina* is the reproductive segment of *Globigerina*, as to which he inclines to a negative conclusion. He describes the curious manner in which the shells of *Globigerinæ* are worked-up into cases for Tubicolar Annelids; of which cases several different types presented themselves, the Foraminiferal shells in some of them being combined with sponge-spicules. A remarkably fine specimen of *Textularia* was met with alive, of which the porous shell was encased by sand-grains; this being laid open by section showed the sarcodic body of an olive-greenish hue, corresponding with that of the *Lituolæ* and *Astrorhizæ* also found alive. Several Rotaline types presented themselves sparingly in the *Globigerina*-mud; these are specially characteristic of the Cretaceous Formation.

The family LAGENIDA was represented not merely by its smaller forms, but also by a large and beautiful living *Cristellaria*, that closely corresponds with one of the forms described by Fichtel and Moll from the Siennese Tertiaries, whilst even exceeding it in dimensions.

These results conclusively show that reduction in the size of *Foraminifera* cannot be attributed to increase of pressure, since the examples of *Cornuspira*, *Biloculina*, and *Cristellaria* found at depths exceeding 500 fathoms were *far larger* than any that are known to exist in the shallower waters of the colder temperate zone. But as these all occurred in the *warm area*, whose bottom-temperature indicates a movement of water from the Equatorial towards the Polar region, it is probable that their size is related to the *temperature* of their habitat, which is found to be in like relation to the general character of the fauna of which they formed part. On the other hand, as we now know that the climate of the deepest parts of the ocean-bottom, even in Equatorial regions, has often (if not universally) Arctic coldness, the dwarfing of the abyssal *Foraminifera* of those regions is fully accounted for on the same principle.

Besides these examples of new or remarkable forms of *Foraminifera*, the 'Lightning' dredgings yielded some peculiar bodies, the examination of which would seem to throw light upon the obscure question of the mode of reproduction in this group. One set of these are cysts, of various shapes and sizes, composed of sand-grains loosely aggregated (as in the tests of *Lituola* and *Astrorhiza*), which, when broken open, are found to be filled with aggregations of minute yellow spherules, not enclosed in any distinct envelope. These are supposed by the author to be *reproductive gemmules* formed by the segmentation of the sarcodic body of a Rhizopod, in the same manner as "zoospores" are formed in Protophytes by the segmentation of their endochrome. Of such segmentation he formerly described indications in the sarcodic body of *Orbitolites*; and corresponding phenomena have been witnessed by Prof. Max Schulze. But in another set of cysts, of similar materials but of firmer structure, bodies are found having all the characters of *ova*, with *embryos* in various stages of development. In none of these, however, does the embryo present characters sufficiently distinctive to enable its nature to be determined; and the hypothesis of the Foraminiferal origin of these bodies chiefly rests upon the conformity in the structure of the wall of the cysts with that of the tests of *Lituola* and *Astrorhiza*, and upon the improbability that such cysts should have been constructed by animals of any higher type.

MISCELLANEOUS.

The Development and Change in the Form of the Horn of the Gnu (Connochetes gnu). By Dr. J. E. Gray, F.R.S.

Mr. Edward Gerrard, jun., has lately purchased the dead body of a half-grown gnu which died shortly after it was imported.

This animal is most interesting as showing the very great change that takes place in the form and direction of the core of the horns and the horns themselves during the growth of the animal. The very young animal is figured by me in the 'Knowsley Menagerie,' but I am not aware that the half-grown animal has ever been described or figured.

The horns in this state, instead of being bent down on the sides of the front of the head, and flattened at the base, as in the adult, are erect, cylindrical, conical, slightly curved, rather lyriform, somewhat like the horn of *Damalis lunata*, but less curved. The horns are rather long, smooth, with a few indistinct rings near the base. The cores of the horns are 6 inches long, conical, erect, like the horns that cover them. The conical horn of this age forms the conical elongated tip to the adult horn.

At a certain age, the core and horn must be gradually bent backwards at the base, and at length they are produced and spread out laterally until, as in the adult animal, they are decumbent on the sides of the head, with a flattened base, recurved upward in the middle, and straight and conical at the end.

The horns on the skull of the half-grown, and especially of the nearly adult animal are so unlike those of the adult, that, if they had been received without the skin, it would be very excusable for a naturalist to have regarded them as a distinct genus intermediate between this genus and the lunated smooth-horned *Damalis*.

The cores of the horns of the young animal are somewhat like those of the skull of the adult Nylghau, but not angulated at the base, and more erect. When the horns are more developed and recurved, as they must be in the intermediate age between the young and the adult form, they must be very unlike those of any known genus of hoofed animals.

The skull of the gnu is peculiar for having the lateral wing of the basisphenoid extended into a broad pointed process in the back of the orbit. This process is only very indistinctly seen in the figures of the skull in the Catalogue of the Ungulata Furcipeda in the Collection of the British Museum, t. 15. f. 4, 5.

On the Development of Cypris. By C. Claus.

The earliest observations on the development of the Ostracoda are due to M. Zenker. He found that at their birth the Cytherides are already provided with their two pairs of antennæ and two pairs of jaws, but that their abdomen is still but slightly developed and bears only three little appendages in place of the future limbs. In 1865 M. Claus published some observations on the larvæ of *Cypris*,

and he now completes this subject by describing all the phases of the development of two other species of that genus.

In contrast to the Cytherides, which present an advanced stage of development at their first appearance, the young freshwater Ostracoda on quitting the egg only possess the three anterior pairs of limbs, like the Nauplius of the Copepoda and Cirripedia. They are distinguished, indeed, from these by the presence of a bivalve shell, which protects them, and by the form of the limbs, of which the first two pairs at least already present the general forms of the corresponding members in the adults. Nevertheless, from a morphological point of view, we may justly regard the young *Cyprides* as Nauplii, especially as the third pair of members in these little creatures displays, both in form and function, peculiarities belonging to that larval form. As in other Nauplii, in fact, the third pair of limbs, corresponding to what will afterwards be the mandibles, do not fulfil the function of jaws, but that of locomotive organs. They are triarticulate reptatory feet, the extremity of which terminates in a strong bristle curved into a hook. In the older larvæ of the Copepoda the mandible buds as a masticatory process at the base of this limb; and so also the reptatory foot of the larvæ of *Cypris* presents at its base a crenulated apophysis, which, at the first change of skin, bcomes converted into a mandible.

The larvæ of *Cypris* pass through a great number of stages before arriving at their ultimate form and at sexual maturity. M. Claus enumerates nine of these phases, separated from each other by a complete moult and by a change of the shell. The most striking character of the second phase is the budding forth of the mandibles above mentioned, accompanied by the metamorphosis of the locomotory foot of the preceding phase into a mandibular palpus. At this same period appear the rudiments of the maxillæ and of the first pair of final locomotory feet. The jaw-feet (maxillæ of the second pair) appear in the fourth phase, and consequently after the first pair of feet, which, however, come after them in the order of succession of the appendages. During the fifth phase, the jaw-feet play the part of locomotory feet, and terminate in a strong hooked bristle. In all phases of development there exists a pair of strong posterior terminal bristles. It is singular that the position and insertion of this bristle is modified in the course of development. Originally it is borne by the mandibular foot, then by the first foot-rudiment, then by the jaw-foot, and then by the locomotory foot of the first pair. The posterior pair of locomotory feet appear at the sixth phase. At the seventh all the extremities have nearly acquired their definitive form. This is the period at which the first rudiments of the generative organs make their appearance; but the sexual differences are not manifested until the eighth stage. The abdomen or postabdomen appears in the fifth phase, in a form exactly similar to that of the rudiments of the limb. This is also the period when the hepatic canals grow and descend into the shell.—*Schriften der Gesellsch. zur Beford. der ges. Naturw. in Marburg*, Bd. ix. 1868, p. 151; *Bibl. Univ.* tome xxxv. August 15, 1869, *Bull. Sci.* pp. 312–314.

On the White-toothed American Beaver. By Dr. J. E. Gray, F.R.S.

The British Museum lately received from Dr. R. Brown three skulls of the American Beaver, which agree in all particulars, and especially in the form of the nasal bones, with the usual American-beaver skulls; but they differ from them in having white cutting-teeth, or with a more or less yellow tinge; all other American and European beavers I have seen have dark red-brown cutting-teeth. The variety may be catalogued as *Castor canadensis leucodonta*. I believe these skulls were procured on the north-west coast of America; but Dr. R. Brown did not state any special locality.

On the Occurrence of Beania mirabilis *and* Labrus mixtus *at Eastbourne, Sussex.* By F. C. S. Roper, F.L.S. &c.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—The beauty and variety of animal and vegetable life on the rock-bound shores of our south-western and northern coasts, where every pool abounds with zoophytes, sponges, and algæ in profusion, has long made them favourite hunting-grounds for all who are interested in these branches of natural history. Many of the small and rare species of zoophytes are only recorded as occurring either on the coasts of Devon or Cornwall, of which the marine zoology has been so well worked up by the labours of Couch, Gosse, and the Rev. T. Hincks, or on the shores of Yorkshire or Northumberland, by Bean, Johnston, and others. The south and south-eastern coasts, where chalky, argillaceous, or sandy strata occur, are less favourable to the growth of these productions, and, as a necessary consequence, have not received the same amount of attention. At the same time I have little doubt that a careful search would be rewarded by the discovery of many species at present only known as inhabitants of more favoured localities. As an instance of this, I have to record the occurrence on the shore at Eastbourne of one of the rarest of the Polyzoa noticed by Dr. Johnston, the *Beania mirabilis*, which appears hitherto only to have been found at Scarborough (by Mr. Bean, its discoverer), at Peterhead, on our northern coasts, where it is said to be very rare, and at several localities in Devon and Cornwall, where, according to the Rev. T. Hincks's 'Catalogue of South-Devon and Cornish Zoophytes,' it is more abundant. The specimen I met with was growing at the base of a mass of *Flustra foliacea* thrown up on the shore by the late heavy gales; and, as Dr. Landsborough observes, the species "is so insignificant when seen by the naked eye, that it would easily be passed over as undeserving of regard." The specimen I have is barely one-fourth of an inch in length, with about eight of the peculiar calycles attached standing up erect from the radicles, which ramify over the lower part of the *Flustra*. From its occurrence on this zoophyte, it would appear to be from deep water rather than from the immediate vicinity of the shore, and probably, by dredging, might be procured in a living state.

I also wish to place on record the capture, this summer, of two specimens (male and female) of the Striped or Cook Wrasse (*Labrus mixtus* of Yarrell), which, from what I hear from the fishermen, is very rarely met with on this coast, though mentioned as an occasional visitor by Mrs. Merrifield in her 'Natural History of Brighton.' According to Couch, it is not uncommon on the Cornish coast, but appears to be rarely met with elsewhere. Both specimens were taken about the same spot, on a shoal about five miles off Eastbourne, the first in a lobster-pot, the other by a line. Of the male I have only seen the dried skin; but the female was brought to me soon after it was caught, and it has been preserved in glycerine, but has lost the brilliancy of colouring which makes it so resemble the wonderful productions of tropical seas in the intensity of the deep-blue stripes bordered by the brilliant orange and yellow tints that cover the mass of the body. Your obedient Servant,

F. C. S. Roper.

On the Origin and Increase of Bacteria. By Dr. A. Polotebnow.

The author's investigations, made in Prof. Wiesner's laboratory, at the Polytechnic Institute of Vienna, have led him to the following results:—

1. That a perfect genetic connexion exists between *Bacterium*, *Vibrio*, and *Spirillum*, and that these present no other differences but those of size and direction.

2. None of the Vibriones (*Vibrio*, *Bacterium*, and *Spirillum*) are independent organisms, but only derivatives (delicate mycelia) from the spores of fungi, especially those of *Penicillium glaucum*.

3. The development of the Vibriones from the spores of *Penicillium* may be best followed when the spores are exposed to the action of a high temperature (140°–212° F.).

4. The notion that Vibriones are developed in the filaments of mycelium from the granules occurring in the cells proves to be quite erroneous, as also that of the conversion of Vibriones into other higher forms (yeast &c.).—*Anzeiger der k. k. Akad. der Wiss. in Wien*, April 29, 1869, pp. 87–88.

Experiments to show that the Fins of Fishes are Regenerated only when their Basal Portion at least is left. By M. J. M. Philipeaux.

The author's experiments on the regeneration of the spleen of the mammalia and the limbs of the newts and axolotl have been extended by him to the fins of fishes.

He cut off the left ventral fin of some gudgeons at the level of the abdominal surface. The fishes were then placed in a basin under favourable conditions, and in eight months the fins were completely reproduced.

In a second series of experiments upon the same species the author entirely extirpated the right ventral fin, including all the small bones which support it; the fishes having been put into the basin, some of them died from the effects of the operation, whilst those which survived showed a perfect cicatrix eight months after the

operation, but no indication of the regeneration of the fin. Broussonet came to the same conclusion; and the author considers that it may be stated as a general law, with regard to vertebrate animals at least, that when an organ is entirely removed, it can never be regenerated.—*Comptes Rendus*, March 15, 1869, tome lxviii. pp. 669–670.

Descriptions of two new Species of Hymenoptera from the Argentine Republic. By J. C. Puls.

Melipona molesta.

Black, shining, entirely covered with white hairs. *Antennæ* black, with their extremity and the lower part of the first joint brownish. *Head* black, shining, covered with white hairs. *Thorax* black, shining, the hairs white; prothorax bordered by a yellowish-white line; mesothorax having a similar line above the insertion of the wings; metathorax having a point of the same colour on each side. *Scutellum* inferiorly bordered by a line of the same colour. *Abdomen* black, shining, covered with white hairs. *Legs* black; tarsi brown. *Wings* hyaline, nervures yellow (worker). Length 4 millimetres.

Hab. San Luis, in woods of small trees. It is very troublesome like the flies. December (*Strobel*).

Odynerus albocinctus.

Black, thorax very villose; abdomen velvety, shining, first segment margined with yellowish white; antennæ and mandibles red; legs red, with the femora black. Length 9 millimetres; expanse 20 millimetres.

♀. *Clypeus* pyriform, with a strong emargination, forming two triangular teeth, punctured. *Antennæ* entirely red; mandibles, palpi, and labrum red. *Head* and *thorax* covered with long, close hairs; metathorax rounded. *Abdomen* black, velvety, shining, sprinkled with longer hairs, the first segment bordered by a thin yellowish-white line; second segment having no tubercle beneath. *Wings* brownish, with the extremity violet; scale black. *Legs* red, with all the femora black, except on their anterior part.

This is the only species that might be confounded with *Odynerus Antuca*, Sauss. (in Gay's 'Chili'), as having the first segment of the abdomen yellowish white; but it differs therefrom by its black clypeus, scales, and femora.

Hab. Near a spring, Portezuelo de Bonilla, in the Sierra de Uspallata, in the province of Mendoza. January (*Strobel*).—*Atti della Società Italiana di Sci. Nat.* vol. xi. pp. 257 & 258, October 1868.

Habits of the Medusæ. By Dr. J. E. Gray.

Mr. M'Andrew informs me that he often saw the Sea-jellies (*Medusa æquorea*, Forskål, Fauna Ægyptiaca, n. 28. t. 32) lying on their backs at the bottom of the beautiful clear water of the Red Sea, with the tentacles expanded like a flower. The Arab sailors dived for them, and brought them up to the surface. The Arabs are very handy in this respect, and will bring up any animal, shell, or stone that may be pointed out to them, jumping in a moment from the

side of the boat into the sea. When disturbed, the medusæ swam about, like other medusæ, with their tentacles below.

Two specimens of this species that Mr. M'Andrew brought home, preserved in spirits, have retained their shape, and are thicker and much firmer than the commoner species of Medusæ.

I am not aware that the habit of lying on the back and expanding the tentacles under water has been observed or recorded before.

On the Reproduction of Pholcus phalangioides, *Walck.* By Dr. Paolo Bonizzi.

The author placed a female of this species in a glass vessel; it immediately formed a web in the upper part of the vase, and the following day deposited its eggs. These were of a dirty white colour with a rosy tinge; their diameter was about 1 millim. There were more than twenty of them, and, as usual, they were not enclosed in a cocoon, but adhered to each other by the stickiness of their surface, and formed a somewhat spherical or ovoid mass. The female carries the eggs suspended from the claws of the mandibles (chelicera), and will not quit them even in the greatest peril.

On a fly being introduced into the vessel, the female quitted the eggs, which remained suspended by a thread attached to those of the web. The author observed that the second and third pairs of feet are employed by the animal to secure its prey, and to hold it in a convenient position for sucking out its juices; the fourth pair is employed to involve the prey rapidly in a thread.

Towards the end of the time of incubation of the eggs, the spider rotated the mass of eggs upon the suspending thread by means of the second and third pairs of feet, and appeared to endeavour to break their shells, touching each of them in turn with the mandibles. The morning after this observation was made, some of the young were hatched, but still remained adhering to the mass of ova; in a few hours they were found scattered over the web, and the empty shells had fallen to the bottom of the vessel. The mother stood near the young, below the space occupied by them; and this the author has also observed in free individuals. When some flies were introduced into the vase, the mother imprisoned them in the usual manner, when the more robust of the young animals ran to suck the insects thus prepared for them. The time of incubation of these ova was nineteen days; but in other cases the author observed it to occupy only seventeen days.

The author describes the nuptials of this species. He introduced a male (which is much smaller than the female) into the glass with the above-mentioned female; the two animals remained immovable for some time, and then the male approached the female very cautiously. The male continued uneasy for a long time before uniting with the female, and from time to time he trembled considerably. The copulation lasted about an hour and a half; and during this time the animals appeared to be almost insensible to slight shocks given to the vessel. At the conclusion of the copulation, the male rapidly quitted the female, and took up his position as far as possible from her, at the bottom of the vessel.—*Annuario della Soc. dei Natural. in Modena*, anno iii. pp. 179–181.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 23. NOVEMBER 1869.

XXXVI.—*On the Coleoptera of St. Helena.* By T. Vernon Wollaston, M.A., F.L.S.

It is now eight years since I gave an enumeration, in the 'Journal of Entomology,' of fourteen species of Coleoptera which had been detected at St. Helena, on the 21st of July 1860, by the late Mr. Bewicke, during a few hours' collecting in that island (*en passant* from the Cape of Good Hope to Madeira). Since then, our knowledge of the fauna has been considerably increased, mainly through the exertions of J. C. Melliss, Esq., a gentleman who is resident on the spot, and who continues to take a lively interest in the various branches of natural science; and although, clearly, *very* much remains yet to be done, two successive consignments which he has entrusted to me of the beetles which from time to time have rewarded his researches enable me now to venture on something like a systematic, though short, catalogue (destined, I hope, hereafter, to be greatly increased) of the St.-Helena Coleoptera.

That a special interest should attach to the productions of any island which is unusually remote, I need scarcely state; and when we recollect that St. Helena is about 1200 miles from the nearest point of the African continent, we shall at once acknowledge that, for the geographical naturalist, a more isolated field could hardly perhaps be found. The manifest deterioration of the island, in a scientific point of view, during the last 300 years, is a subject on which I need not dilate; for the primeval forests which are said to have more or less clothed it at its discovery have succumbed beneath the ruthless hand of "civilization,"—a few detached patches alone remaining, on the extreme summit and more inaccessible slopes, to harbour what is left of that noble fauna the fragments of which are so eccentric that one cannot but suspect the *quondam*

occurrence of many intermediate links (now, in all probability, long exterminated) which must, as it were, have "articulated them on" to the recognized types with which we are familiar. Of course in an island of this kind, which has become intensely cultivated since the period of its colonization, we naturally should not expect to meet with many traces of its primeval species; for the gradual rooting-out of the native vegetation, and the introduction, year after year, of more "useful" plants (chiefly from European latitudes, but in the present instance, perhaps, partly from the Cape of Good Hope), accompanied by their inevitable train of insect parasites, would so far alter the entire country as to destroy the apparent peculiarity of its productions, and give a mixed character to its fauna and flora to which aboriginally it had no kind of claim. Happily, however, in cases like this, when the species are brought fairly together, it is usually not difficult for a practised eye to separate *in a general way* the species which are strictly endemic from those which have subsequently been introduced and become naturalized; and thus it is that out of the seventy-four which are enumerated in the following catalogue, there are only thirteen concerning which I have (in that particular respect) much doubt. Indeed what we may term the "*ultra*-indigenous" species speak at once, and unmistakeably, for themselves; and in like manner as regards those which are more or less cosmopolitan, or which have found their way, through human agencies, into nearly every country which has the slightest intercommunication with the civilized world, there can be no question. These manifest *importations* last mentioned, which, however, figure so largely in the St.-Helena list, have no real bearing on the true fauna of any single region beyond those whence they were originally disseminated, and for the most part owe their presence in local catalogues merely to the amount of research which may happen to have been made in the houses, stores, gardens, and merchandise around the various ports and towns. Yet, on the other hand, they cannot be omitted or ignored; for some of them may have taken so firm a hold on the newly acquired area as to occupy a prominent place amongst its primeval organisms, and even perhaps to have aided indirectly in their very extermination. This latter contingency, however, seems to me to represent the exception rather than the rule; for I have myself generally observed that the species which are manifestly imported linger almost exclusively about the "inhabited regions," and seldom attach themselves to those which are emphatically wild and uncultivated—and even if in a few instances they should do so, that their *modus vivendi* is totally different from that of the

veritable *autochthones* of the soil. To these *unquestionably* established forms I have, in the subjoined list, placed (as an aid to the eye) an asterisk (*).

Bearing in mind, therefore, the above considerations, I may add that out of the seventy-four species enumerated in the present paper, only thirty-five (or less than half) appear to be *unmistakably* indigenous, whilst the *evidently imported* ones (species which through human agencies have become widely disseminated over more or less of the civilized world) amount to about twenty-six, leaving a residuum of thirteen which I should perhaps characterize as "doubtful," but the majority of which nevertheless have *in all probability* been naturalized. The thirty-five which seem to be as it were the actual *autochthones* of the soil, or which there is no reason to suspect have been derived from any other country, are the following:—

Haplothorax Burchellii.
Calosoma haligena. } *an vere*
—— Helenæ. } *distinctæ?*
Bembidium Mellissii.
Adoretus versutus.
Pentarthrum subcæcum.
Nesiotes squamosus.
—— asperatus.
Trachyphlœosoma setosum.
Sciobius subnodosus.
Heteronychus arator.
Mellissius eudoxus.
—— adumbratus.
Heteroderes puncticollis.
Microxylobius Westwoodii.
—— vestitus.
—— lacertosus.
—— lucifugus.
Microxylobius terebrans.
—— obliteratus.
—— debilis.
—— Chevrolatii.
—— conicollis.
—— monilicornis.
Notioxenus Bewickii.
—— rufopictus.
—— dimidiatus.
—— alutaceus.
Homœodera rotundipennis.
—— alutaceicollis.
—— pygmæa.
Longitarsus Helenæ.
Cydonia lunata.
Opatrum hadroides.
Mordella Mellissiana.

whilst the twenty-six which clearly have followed in the track of civilization and commerce are these:—

Læmophlœus pusillus.
Cryptophagus affinis.
Mycetæa hirta.
Typhæa fumata.
Dermestes cadaverinus.
—— vulpinus.
Attagenus gloriosæ.
Aphodius lividus.
Corynetes rufipes.
Gibbium scotias.
Anobium velatum.
—— paniceum.
—— striatum.
Anobium confertum.
Rhizopertha bifoveolata.
—— pusilla.
Hylurgus ligniperda.
Sitophilus oryzæ.
Otiorhynchus sulcatus.
Aræocerus fasciculatus.
Alphitobius diaperinus.
—— piceus.
Gnathocerus cornutus.
Tribolium ferrugineum.
Tenebrio obscurus.
Creophilus maxillosus.

This leaves the following thirteen, already alluded to as

"doubtful," the majority of which, however, have *most likely* been, through various causes, naturalized:—

Pristonychus complanatus.	Stenoscelis hylastoides.
Dactylosternum abdominale.	Bruchus rufobrunneus.
Sphæridium dytiscoides.	—— advena.
Cryptamorpha musæ.	Aspidomorpha miliaris.
Tribalus 4-striatus.	Epilachna chrysomelina.
Saprinus lautus	Zophobas concolor.
Tomicus æmulus.	

If it be permissible, from material so limited as that which has hitherto been amassed, to build up a rough estimate of the true Coleopterous population of St. Helena, it is clear that the twenty-six "cosmopolitan" species, which have manifestly followed in the wake of mere commerce and civilization, must be altogether set aside; and in that case, giving the thirteen more or less equivocal ones the advantage of the doubt, we should have forty-eight to represent the aboriginal (and evidently much reduced) fauna of this remote deteriorated island. When commenting, in 1861, on even the fourteen species which had been collected by Mr. Bewicke, I called attention to the extraordinary fact that not only did the weevils number nearly two-thirds of the entire batch, but were likewise *all of them endemic, both as regards species and genus*! whilst certainly three, if not indeed more, out of the remaining six (belonging to other families) possess a wide geographical range. This led me to remark that the *Curculionidæ* would, in all probability, be found to play a most important part in the Coleopterous fauna of St. Helena; and I then expressed my belief, *from the mere diversity of configuration* presented by the five species of *Microxylobius* which had been brought to light, that the members of that abnormal little group would *almost certainly* be ascertained to be locally abundant, and, "since the same might be urged with no less force for that extraordinary genus *Notioxenus*," that there was "every reason to suspect that the *Rhynchophora* of this mountain-island are, in proportion to its size, both numerous and eccentric."

I have thought it worth while to allude to these casual observations of my own, because they have been so strictly and literally verified. Not only have *Microxylobius* and *Notioxenus* been augmented by newly discovered exponents, but everything tends to prove that they are immeasurably the most significant of the island forms: indeed an undescribed and closely related *genus* has been detected alongside the latter, as though still further to enhance the local importance of that particular Anthribideous type. Scarcely less characteristic, however, than even these three, are, perhaps, the obscure Cur-

culionideous groups *Nesiotes* and *Trachyphlœosoma*; and, if indeed it be truly aboriginal (and there is no reason for suspecting the contrary), that curious little blind Cossonid, the *Pentarthrum subcœcum*, may be added to the number, in which case the *Rhynchophora alone* would monopolize no less than six of the most anomalous endemic *genera*! Indeed the only other manifestly indigenous forms which I should define as *par excellence* "abnormal" are *Haplothorax* of the Carabidæ, and perhaps *Mellissius* of the Lamellicorns, neither of which, however, are so eccentric in their structure as the six Rhynchophorous ones to which I have just alluded.

Apart, however, from their singularity of type, it may be useful, in order to illustrate the mere numerical preponderance of the weevils (as regards both species and genus) in the St.-Helena catalogue, to distribute the forty-eight members of the fauna (to which I have already called attention) under the twelve great sections into which the Coleoptera are usually supposed to arrange themselves. I am well aware that the paucity of the list itself, and *perhaps* likewise the totally unexplored state of the pools and streams, may be sufficient to account for many an apparent anomaly—such as, for instance, the complete absence of the water-beetles and *Brachelytra*; but still, after making every allowance for the manifest imperfection of the material, the broad fact does undoubtedly remain that the researches of Messrs. Melliss, Bewicke, and others (and that, too, whilst by no means neglecting the minuter groups) have brought to light more representatives of the *Rhynchophora* than of all the other departments combined. And that this is truly the case, a glance at the following table will suffice to show:—

Rhynchophora	26
Cordylocerata (*i. e.* Lamellicorns &c.)	6
Geodephaga	5
Heteromera	3
Philhydrida	2
Phytophaga	2
Pseudotrimera	2
Necrophaga	1
Priocerata	1
Hydradephaga	0
Brachelytra	0
Eucerata	0
	48*

* It is scarcely necessary to consider what would be the result were the whole seventy-four species which are enumerated in the present list distributed under these twelve primary departments, because (as already

It will be seen, on reference, that the seventy-four species of the subjoined list distribute themselves under twenty-eight families and no less than fifty genera. Of these seventy-four species I have been compelled to treat about forty as if they had not been detected in any other country, though it is probable that some five or six of them (as, for instance, the *Histeridæ*, the *Anobium confertum*, and the *Bruchi*) will be found eventually to have been already described. The seven *genera* which would appear to be peculiar to the island are *Haplothorax* (of the Carabidæ), *Mellissius* (of the Dynastidæ), *Microxylobius*, *Nesiotes*, and *Trachyphlœosoma* (of the Curculionidæ), and *Notioxenus* and *Homœodera* (of the Anthribidæ), three of which (*Mellissius*, *Trachyphlœosoma*, and *Homœodera*) have been enunciated for the first time in this memoir. The *species* which in the present paper I have described as new are the twenty-five following:—

Bembidium Mellissii.
Tribalus 4-striatus.
Saprinus lautus.
Mellissius eudoxus.
—— adumbratus.
Heteroderes puncticollis.
Anobium confertum.
Tomicus æmulus.
Microxylobius vestitus.
—— obliteratus.
—— debilis.
—— monilicornis.
Pentarthrum subcæcum.
Nesiotes asperatus.
Trachyphlœosoma setosum.
Sciobius subnodosus.
Notioxenus dimidiatus.
—— alutaceus.
Homœodera rotundipennis.
—— alutaceicollis.
—— pygmæa.
Bruchus rufobrunneus.
—— advena.
Zophobas concolor.
Mordella Mellissiana.

If we exclude from consideration the twenty-six species (above alluded to) which have *unquestionably* been brought into the island through the medium of commerce, and which enter into the fauna of nearly every civilized country, I need scarcely add that the St.-Helena list, as hitherto made known, possesses nothing whatever in common with those of the three sub-African archipelagos which lie further to the north—though the great development of the Curculionideous subfamily *Cossonides* is a remarkable fact which is more or less conspicuous throughout the whole of them.

stated) the twenty-six which have *manifestly* been introduced (and most of them, perhaps, quite recently) can have no real connexion with the true fauna of the island; nevertheless, even were we to do so, the *position* of the *Rhynchophora* as the most extensive of the various groups (although its relative proportion to them would be lowered) would remain the same. Whilst in the former case, however, it numbers twenty-six, and the remaining sections (combined) twenty-two, in this instance it would contain thirty, and the other eleven divisions forty-four.

Fam. 1. Carabidæ.

Genus 1. HAPLOTHORAX.

Waterhouse, Trans. Ent. Soc. Lond. iii. 207 [script. *Aplothorax*] (1841).

1. *Haplothorax Burchellii.*

Aplothorax Burchellii, Waterh., *loc. cit.* pl. 12. f. 1 (1841).

A truly indigenous and noble Carabid, which appears, however, to be both local and extremely scarce. Although received many years ago from St. Helena, where it was first detected by the African traveller Dr. Burchell, the only examples of it which I have myself seen have been captured by Mr. Melliss.

Genus 2. CALOSOMA.

Weber, Obs. Ent. 20 (1801).

2. *Calosoma haligena.*

C. supra aut obscure æneum aut fere (vel etiam omnino) nigrum, subopacum; capite irregulariter punctato; prothorace parvo, transverso-subcordato, antice ad latera valde rotundato, angulis posticis retrorsum productis sed obtusis, densissime ruguloso-punctato, utrinque intra angulos posticos late et profunde impresso; elytris grosse crenato-striatis, interstitiis æqualiter elevatis ac transversim imbricato-rugatis, punctis magnis plus minus ænescentibus vel cuprescentibus in triplici serie notatis; antennis pedibusque nigris aut piceo-nigris.

Mas, plerumque vix minor, pedibus sensim crassioribus, tibiis posterioribus (præsertim intermediis) conspicue curvatis, tarsis anticis valde dilatatis.

Fœm., plerumque vix major, pedibus sensim gracilioribus, tibiis intermediis vix curvatis, posticis fere rectis, tarsis anticis simplicibus.

Long. corp. lin. 9–11.

Calosoma haligena, Woll., Journ. of Ent. i. 208 (1861).

Of this fine *Calosoma* a single example was captured at St. Helena (in July 1860) by the late Mr. Bewicke, and several more have since been communicated by Mr. Melliss. It seems to belong to the same type as the African species *senegalense* and *rugosum*, from the former of which it is nevertheless abundantly distinct. From the latter it differs (*inter alia*) in being more depressed, and in having its coppery punctures smaller, in its prothorax being more deeply rugose before and behind, and in its legs being less robust. As regards colour, it appears to be either dull brassy or nearly (if not indeed altogether) black; and its males have their four

posterior tibiæ (particularly, however, the intermediate pair) conspicuously curved, whilst in the opposite sex the hinder ones are nearly (if not quite) straight, and even the middle pair but *very* slightly bent inwards. Whether the *C. Helenæ* of Hope was established on an unusually small and dark individual of this species I cannot feel quite positive; but as the published description of it does not by any means tally with the *C. haligena*, I am compelled (in the absence of evidence which is positive) to retain the two as distinct. If, however, they should prove ultimately to be conspecific, I need scarcely add that the name of *Helenæ* (as the prior one) will of course have to be adopted.

3. *Calosoma Helenæ.*

C. "atrum; elytrorum margine æneo; antennis basi piceis, pedibusque nigris. Long. lin. 8; lat. lin. 3½.

"Habitat in ins. Sanctæ Helenæ. *In Mus. Dom. Darwin.*

"Atrum; elytris striatis margine æneo, punctisque excavatis triplici serie dispositis. Antennæ 4 primis articulis piceis, reliquis fusco-pubescentibus. Corpus supra et infra nigrum. Thorax transverse ovatus, marginatus. Elytra striata, subrugosa; marginibus externis subvirescentibus, punctisque excavatis triplici serie ordinatis. Pedes nigri, tibiis intermediis incurvis." [Ex *Hope.*]

Calosoma Helenæ, Hope, Trans. Ent. Soc. Lond. ii. 130 (1838).

Although perhaps it is scarcely likely that so small an island as St. Helena should possess two species of *Calosoma*, nevertheless, since the above description (which I have transcribed *verbatim* from Mr. Hope's paper) does not by any means agree with that of the *C. haligena*, I can scarcely take upon myself to regard the *C. Helenæ* as identical with the latter, and I have therefore (until at any rate further evidence shall settle the question) cited it as distinct. Judging from the published diagnosis, the *C. Helenæ* would appear to be smaller than the *haligena*; and it is stated to be deep black, though there is of course a possibility that the more *brassy* form did not happen to be included amongst the individuals which were examined by Mr. Hope. In the *C. Helenæ* the elytra, too, are defined as merely "striata, subrugosa;" whereas those of the *haligena* are deeply crenate-striate and have their interstices transversely imbricated in a most coarse and conspicuous manner; and the *intermediate* tibiæ only of Mr. Hope's species are said to be curved, whereas in the *C. haligena* the *four* hinder ones of the male sex are powerfully arcuate. Still, it is of course possible that the *C. Helenæ* may have been defined from an unusually small and dark example of what I subsequently enunciated under the trivial name of

haligena; and if that should prove eventually to have been the case, the title proposed for the species by Mr. Hope will have to be retained.

Genus 3. PRISTONYCHUS.

Dejean, Spec. des Col. iii. 43 (1828).

4. *Pristonychus complanatus.*

Pristonychus complanatus, Dej., *loc. cit.* 58 (1828).
—— *alatus*, Woll., Ins. Mad. 27 (1854).
—— *complanatus*, Id., Col. Atl. 27 (1865).
Læmosthenes complanatus, Harold, Cat. Col. 356 (1868).

An insect of a widely acquired geographical range, particularly, however, in Mediterranean latitudes—occurring in Portugal, Spain, the south of France, Italy, Sardinia, Sicily, Egypt, Barbary, &c. It is abundant also in the Azores, Madeiras, and Canaries, and has been reported even from Chili. At St. Helena it has been met with both by Mr. Melliss and the late Mr. Bewicke; and I have seen examples of it from the same island in the collection of Mr. A. Fry.

Genus 4. BEMBIDIUM.

Latreille, Hist. Nat. viii. 221 (1804).

(Subgenus *Notaphus*, Dej.)

5. *Bembidium Mellissii*, n. sp.

B. oblongum, subopacum, alutaceum; capite prothoraceque subæneo nigro-viridibus, hoc brevi subcordato, utrinque intra angulos posticos profundo impresso (impressionibus extus striola terminatis); elytris depressiusculis, profunde striato-punctatis (striis postice evanescentibus), lurido-testaceis sed fasciis maculisve disjunctis nigrescentibus ornatis; antennis pedibusque piceo-testaceis, illis versus apicem horumque femoribus paulo obscurioribus.
Mas, tarsorum anticorum art° basilari valde dilatato.
Long. corp. lin. 2.

Two examples only of this beautiful *Bembidium* (which belongs to the same group as the European *B. varium* and *flammulatum*) were taken by Mr. Melliss; but I have no note as to the precise locality. It is well distinguished by its dull brassy-green head and prothorax, and lurid-testaceous elytra—the latter of which are ornamented with a number of darker fasciæ and cloudy patches, forming (on each elytron) a large subapical blotch, a postmedial zigzag (or deeply dentate) fascia, and two squarish antemedial spots placed in an oblique direction (from the shoulder) on the fore disk. The elytral striæ

are coarsely and closely punctured, or crenate, and there are two large punctiform impressions on the third interval from the suture.

Fam. 2. **Sphæridiadæ.**

Genus 5. DACTYLOSTERNUM.

Wollaston, Ins. Mad. 99 (1854).

6. *Dactylosternum abdominale.*

Sphæridium abdominale, Fab., Ent. Syst. i. 79 (1792).
Dactylosternum Roussetii, Woll., Ins. Mad. 99, tab. iii. f. 1 (1854).
—— *abdominale*, Id., Col. Atl. 80 (1865).
—— ——, Id., Col. Hesp. 48 (1867).

Several specimens of this widely spread insect were taken in St. Helena by Mr. Melliss, and there can be no doubt that the species has become naturalized in the island through human agencies. Although found more particularly in Mediterranean latitudes, it has acquired an extended geographical range—occurring in the Azorean, Madeiran, Canarian, and Cape Verde archipelagos, and being reported even from Madagascar, Bourbon, and the East Indies.

Genus 6. SPHÆRIDIUM.

Fabricius, Syst. Ent. 66 (1775).

7. *Sphæridium dytiscoides.*

S. "ferrugineum, elytris atris. Habitat in ins. St. Helenæ. *Mus. Dom. Banks.* Statura et magnitudo *S. scarabæoides*; totum glabrum, nitidum. Antennæ rufæ, perfoliatæ. Caput, thorax, pectus, abdomen rufa; elytra atra, glabra." [Ex *Fabricio.*]

Sphæridium dytiscoides, Fab., Syst. Ent. 67 (1775).
—— ——, Oliv., Ent. 2. 15, tab. 2. f. 10 (1790).
—— ——, Fab., Ent. Syst. i. 79 (1792).
—— ——, Id., Syst. Eleu. i. 94 (1801).

I have no means of determining what this insect (the diagnosis of which I have copied *verbatim* from the 'Systema Entomologiæ') really is; but, judging from the rough figure of it which is given by Olivier, it would appear to me to be either a true (though possibly small) *Sphæridium* or else an unusually large *Cercyon*, or (still more probably perhaps) a *Cyclonotum*—with the head and prothorax rufo-ferruginous and the elytra black. Nevertheless, as it was described by Fabricius from a specimen (or specimens) in the cabinet of Sir Joseph Banks, which had been obtained at St. Helena, I have no choice but to include it in the present enumeration; and I can only hope that some future collector in the island may again

bring the species to light, and so enable us to decide positively what it is.

Fam. 3. **Cucujidæ.**

Genus 7. Læmophlœus.

(Dejean) Erichs., Nat. der Ins. Deutsch. iii. 315 (1845).

8. *Læmophlœus pusillus**.

Cucujus minutus, Oliv. [nec Kugel. 1791], Ent. iv. bis, 8, 9 (1795).
—— *pusillus*, Schön., Syn. Ins. iii. 55 (1817).
Læmophlœus pusillus, Woll., Col. Atl. 132 (1865).

Of the little *L. pusillus*—an insect so liable to transmission, along with grain and other articles of commerce, throughout the civilized world—a single example is now before me which was taken by Mr. Melliss at St. Helena; but, having clearly no connexion with the real fauna of the island, it is of little geographical importance. The species has, in like manner, established itself in the Madeiran and Canarian groups.

Genus 8. Cryptamorpha.

Wollaston, Ins. Mad. 156 (1854).

9. *Cryptamorpha musæ.*

Cryptamorpha musæ, Woll., *loc. cit.* 157, tab. iv. f. 1 (1854).
—— ——, Id., Cat. Mad. Col. 51 (1857).
—— ——, Id., Col. Atl. 133 (1865).

A single example of this prettily marked insect—which in Madeira occurs beneath the loose outer fibre of Banana stems in and around Funchal—has been taken at St. Helena by Mr. Melliss. I have no note as to its exact place of capture; but if (as in Madeira) it is attached to the Bananas, in all probability the species has been introduced into the island.

Fam. 4. **Cryptophagidæ.**

Genus 9. Cryptophagus.

Herbst, Käf. iv. 172 (1792).

10. *Cryptophagus affinis**.

Cryptophagus affinis, Sturm, Deutschl. Fna. xvi. 79 (1845).
—— ——, Erich., Nat. der Ins. Deutschl. iii. 360 (1846).
—— ——, Woll., Col. Atl. 137 (1865).

A common European *Cryptophagus* which—like *Læmophlœus pusillus*, *Mycetæa hirta*, and others—must clearly have been imported into the island from more northern lati-

tudes; and therefore, even if fairly established (as is the case with it in the Azorean, Madeiran, and Canarian groups), it can of course have no connexion whatever with the original fauna of St. Helena. A single specimen of it, which I have examined with great care, has been captured (in all probability in some house or granary) by Mr. Melliss.

Fam. 5. **Mycetophagidæ.**

Genus 10. MYCETÆA.

(Kirby) Steph., Ill. Brit. Ent. iii. 80 (1830).

11. *Mycetæa hirta**.

Dermestes fumatus, Mshm. [nec Linn., 1767], Ent. Brit. 65 (1802).
Silpha hirta, Mshm., Ent. Brit. 124 (1802).
Cryptophagus hirtus, Gyll., Ins. Suec. i. 184 (1808).
Mycetæa fumata, Steph., Ill. Brit. Ent. iii. 81 (1830).
—— *hirta*, Woll., Col. Atl. 156 (1865).

The widely distributed European *M. hirta*—which is so eminently liable to become naturalized, in houses and cultivated spots, throughout the civilized world—appears, from a single example now before me which was taken by Mr. Melliss, to have established itself at St. Helena; but, like so many others of the species alluded to in this paper, it can have nothing whatever to do with the real fauna of the island. It has, in like manner, been introduced into the Azorean and Madeiran archipelagos, in the latter of which I have usually met with it crawling on the inner walls of houses.

Genus 11. TYPHÆA.

(Kirby) Steph., Ill. Brit. Ent. iii. 70 (1830).

12. *Typhæa fumata**.

Dermestes fumatus, Linn., Syst. Nat. ii. 564 (1767).
Typhæa fumata, Woll., Col. Atl. 157 (1865).
—— ——, Id., Col. Hesp. 78 (1867).

There is scarcely any insect which has acquired (doubtless through human agencies) a wider geographical range than the common European *T. fumata*; and therefore it is not surprising that it should have been met with by Mr. Melliss (judging from a single example which he has communicated to me) at St. Helena. It occurs in the north of Africa, and abounds in the Azores, Madeiras, Canaries, and Cape Verdes; and it has even been reported likewise from the United States.

Fam. 6. Dermestidæ.

Genus 12. DERMESTES.

Linnæus, Syst. Nat. ii. 561 (1767).

13. *Dermestes cadaverinus**.

Dermestes cadaverinus, Fab., Syst. Ent. 55 (1775).
—— ——, Oliv., Ent. ii. 9. 3 (1790).
—— *domesticus*, (Gebl.) Germ., Ins. Spec. Nov. 85. 143 (1824).
—— *cadaverinus*, Woll., Ann. Nat. Hist. vii. 301 (1861).

This widely spread *Dermestes* having originally been described by Fabricius (in 1775) from a St.-Helena example, in the collection of Sir Joseph Banks, it seems scarcely right to omit it from the present memoir, even though I do not myself happen to have seen a specimen of it from that island. Being peculiarly liable to transmission, in various articles of merchandise and commerce, throughout the civilized world, it has been made to acquire a very extensive geographical range,—being recorded not only in Europe, but even from South America, Mexico, Otaheite, the East Indies, Siberia, Arabia, &c.; and it was obtained abundantly, by the late Mr. Bewicke, at Ascension. Speaking of it, in 1861, in a short paper on Ascension Coleoptera, I remarked that "it belongs to the second of Erichson's sections, in which the *third* and fourth abdominal segments of the males (instead of the fourth alone) are furnished beneath with a little circular *fossette* armed with a cone (or convergent fasciculus) of powerful bristles. In specific details, it may be known from its several allies by its (black) upper surface being uniformly and rather densely clothed with a coarse yellowish-cinereous pile, by its rather elongate and slightly narrow outline, and by its abdominal under segments having, each of them, two roundish patches of darker pile in their centre (gradually *diminishing* and *approximating* in each successive segment towards the apex), and a sublunate one at either lateral edge."

14. *Dermestes vulpinus**.

Dermestes vulpinus, Fab., Spec. Ins. i. 64 (1781).
—— ——, Woll., Col. Atl. 159 (1865).
—— ——, Id., Col. Hesp. 79 (1867).

An example of this almost cosmopolitan *Dermestes* (which is so well characterized by the very minute spinule with which the extreme apex of each of its elytra is furnished) was taken by Mr. Melliss at St. Helena; but the species, which (like the *D. cadaverinus*) is so eminently liable to accidental dissemination along with various articles of commerce and mer-

chandise, is of course totally unconnected with the true fauna of the island. It has been established equally in the Madeiran, Canarian, and Cape Verde groups.

Genus 13. ATTAGENUS.

Latreille, Hist. Nat. iii. 121 (1802).

15. *Attagenus gloriosæ**.

Anthrenus Gloriosæ, Fab., Syst. Eleu. i. 107 (1801).
Æthriostoma gloriosæ, Motsch., Etud. Ent. 140 (1858).
Attagenus Gloriosæ, Woll., Ann. Nat. Hist. vii. 301 (1861).

Of this prettily fasciated *Attagenus*—which has acquired, through the medium of commerce, an almost cosmopolitan range—two examples, now before me, were captured by Mr. Melliss at St. Helena. The species has established itself likewise in the island of Ascension—where it was taken, during April 1860, by the late Mr. Bewicke; and it is reported also from India, Eastern Africa, and America.

Fam. 7. **Histeridæ.**

Genus 14. TRIBALUS.

Erichson, in Klug, Jahrb. i. 164 (1834).

16. *Tribalus 4-striatus*, n. sp.

T. rotundato-ovalis, piceo-niger, nitidus, ubique (in disco levius) punctatus; fronte minutius punctulata, subsemicirculari, angulis anticis subrectis, oculis parvis, simplici (nec transversim carinata); elytrorum striis 4 *dorsalibus* sat profundis, punctatis, usque ad medium ductis, *suturali* nulla sed ad basim ipsam breviter arcuatim conspicua, *humerali* tenui obliqua; pygidio perpendiculari; antennis pedibusque piceis; tibiis anticis leviter circa 5- vel 6-denticulatis.

Long. corp. lin. vix $1\frac{1}{2}$.

The rather small size and entirely punctulated surface of this little Histerid, combined with its semicircular *un*carinated forehead, and the fact of its elytra being totally free from a sutural stria (which is only traceable as a very short subscutellar arcuated impression), affiliate it with the small group of species which constitute the genus *Tribalus*; but it seems to differ (*inter alia*) from the whole of them in having *four* very distinct dorsal punctured striæ continued to about the middle of each elytron. Apart from other characters, its piceous-black hue, subrufescent limbs, and perpendicular pygidium will serve additionally to distinguish it. The single example from which the above diagnosis has been compiled

was communicated by Mr. Melliss, along with his other St.-Helena captures.

Genus 15. SAPRINUS.

Erichson, in Klug, Jahrb. i. 172 (1834).

17. *Saprinus lautus*, n. sp.

S. submetallicus, nitidissimus; capite prothoraceque æneseentibus, illo dense punctato, fronte ab epistomate linea transversa distincte divisa, hoc versus latera et basin grosse punctato, in disco læviore, ad latera nudo (nec ciliato); elytris cyaneis (vel subvirescenti-cyaneis), sat dense ruguloso-punctatis, punctis in disco antico et versus humeros obsoletis, striis *humeralibus* obsoletis, *subhumerali* distincta, longe ultra medium postice ducta, 4 *dorsalibus* ad medium terminatis (4[ta] in *suturalem* integram antice arcuatam coëunte); pygidio propygidioque obscurioribus, profunde punctatis; antennis pedibusque nigro-piceis; tibiis anticis circa 8–9-denticulatis.

Long. corp. lin. 3.

The blue tinge (at any rate on the elytra) and by no means small size of this *Saprinus* are somewhat suggestive at first sight of the widely spread *S. semipunctatus*; but the fact of its epistome being divided from the forehead by a strong transverse line, in conjunction with its sutural stria being complete, and uniting in front with the fourth discal one, remove it into a totally different section of the genus—characterized by such North-American species as *Javeti*, *patruelis*, and *dimidiatipennis*, which, however, appear to be of considerably smaller stature and less punctured on the surface. A single example of this species is amongst the Coleoptera found by Mr. Melliss at St. Helena.

Fam. 8. **Aphodiadæ.**

Genus 16. APHODIUS.

Illiger, Käf. Preuss. i. 28 (1798).

18. *Aphodius lividus**.

Scarabæus lividus, Oliv., Ent. i. 3. 86 (1789).
Aphodius lividus, Woll., Col. Atl. 178 (1865).
—— ——, Id., Col. Hesp. 89 (1867).

A single example of this widely spread European *Aphodius*—which occurs throughout northern and western Africa, and in the Azorean, Madeiran, Canarian, and Cape Verde archipelagos—is amongst the Coleoptera collected at St. Helena by Mr. Melliss; but as it is an insect which easily becomes disseminated through indirect human agencies (particularly the

transportation of cattle), I feel satisfied that it has no connexion whatever with the original fauna of so remote an island.

Fam. 9. **Rutelidæ.**

(Subfam. ANOPLOGNATHIDES.)

Genus 17. ADORETUS.

(Eschcholtz) De Casteln., Hist. Nat. des Col. ii. 142 (1840).

19. *Adoretus versutus.*

A. ovato-oblongus, elongatus, depressiusculus, sat nitidus, valde alatus, brunneus pilisque brevibus cinereis demissis parce irroratus; capite prothoraceque obscurioribus, illo magno rugose punctato, clypeo semicirculari ad marginem recurvo, oculis maximis, hoc brevissimo marginato grosse punctato, ad latera rotundato, angulis anticis porrectis, posticis rotundato-obtusis; elytris elongatis, punctato-rugosis (punctis, saltem majoribus versus latera, subseriatim dispositis), parce longitudinaliter costatis; antennis pedibusque rufo-ferrugineis; tibiis anticis extus 3-dentatis: unguiculis inæqualibus.

Long. corp. lin. $5\frac{1}{2}$–6.

Adoretus vestitus, Bohem. [nec Reiche, 1847], Res. Eugen. 56 (1858).
—— *versutus*, Harold, Col. Hefte, v. (1869).

An *Adoretus* which appears to be rather common at St. Helena. It may be known amongst the few Lamellicorns here enumerated by its narrowish, oblong outline, less convex body (which is sparingly clothed with a short, decumbent, cinereous pile) and more *yellowish*-brown hue, by its rather large head, greatly developed eyes, and semicircular clypeus, by its extremely abbreviated prothorax and subcostate, rugulose elytra, and by its unequal claws. The examples from which I have drawn out the above diagnosis were captured by Mr. Melliss.

Fam. 10. **Dynastidæ.**

(Subfam. PENTODONTIDES.)

Genus 18. HETERONYCHUS.

(Dejean) Burm., Handb. der Ent. v. 90 (1847).

20. *Heteronychus arator.*

Scarabæus arator, Fab., Ent. Syst. i. 33 (1792).
Geotrupes arator, Fab., Syst. Eleu. i. 21 (1801).
Heteronychus arator, Burm., *loc. cit.* 94 (1847).
—— *Sanctæ-Helenæ*, Blanch., Voy. Pôle Sud, iv. 105, pl. 7. f. 6 (1853).
—— *arator*, Woll., in Journ. of Ent. i. 210 (1861).

The South-African *H. arator* appears to be common at St.

Helena—where it was taken by the late Mr. Bewicke in 1860, and subsequently in considerable abundance by Mr. Melliss. It is conspecific with the insect characterized by Blanchard in the entomological portion of Dumont d'Urville's 'Voyage au Pôle Sud sur les Corvettes l'Astrolabe et la Zélée' (p. 105, pl. 7. f. 6) under the title of *H. Sanctæ-Helenæ.*

Apart from its numerous and strictly generic characters, the *H. arator* may at once be known from the two species of *Mellissius* by being rather smaller, darker, brighter, and more cylindric, by its clypeus being more rugose, and bisinuated (instead of truncate) in front, by its prothorax being unsculptured, and by the punctures of its elytra being distributed in regular striæ. Amongst other features, its antennæ are 10- (instead of 9-) articulate, its propygidium is furnished with two long file-like divergent bands for the purpose of stridulation by friction against the inner surface of the apex of its elytra, and its wings are fully developed.

Genus 19. Mellissius (nov. gen.).

Corpus crassum, supra nudum, subtus pilis longis robustis obsitum: *capite* triangulari, *clypeo* apice truncato, necnon ibidem atque subito in genis (ante oculos) plus minus incrassato recurvo, *fronte* in medio vel obsolete vel conspicue tuberculata: *prothorace* magno, convexo, ad latera subæqualiter valde rotundato, in utroque sexu nisi fallor (certe in masculo) simplici, nec antice impresso; *prosternali lobo* (inter coxas anticas) brevi, piloso: *scutello* semicirculari-triangulari: *alis* minutis, obsoletis: *instrumentis stridulantibus* aut fere nullis, aut propygidium pliculis brevibus tuberculisve transversis ubique dense asperantibus. *Antennæ* 9-art$^{\text{is}}$: art$^{\text{o}}$. 1$^{\text{mo}}$ elongato, robusto, subclavato, subflexuoso, 2$^{\text{do}}$ brevi transverso, 3$^{\text{tio}}$ minore breviore, 4$^{\text{to}}$, 5$^{\text{to}}$, 6$^{\text{to}}$ gradatim paulo crescentibus, reliquis clavam magnam, foliatam, ovalem, 3-articulatam efficientibus. *Labrum* clypeo absconditum. *Mandibulæ* corneæ, robustæ, subtriangulares, concavæ, apice incurvæ obtusæ, extus setis longissimis instructæ. *Maxillarum lobus internus* obsoletus, *externus* latus, suboblongus, setisque longissimis ubique obsitus. *Palporum maxillarium articulus ultimus* obovato-oblongus, *labialium* subobovatus. *Mentum* (ligulam occultans) elongatum, subtriangulare, corneum, pilis longissimis obsitum. *Pedes* fossorii, robusti, subæquales: *tibiis anticis* extus fortiter tridentatis, *posterioribus* apice truncatis ciliatis: *tarsorum articulo basilari* subtriangulari, ultimo *unguiculis* æqualibus armato.

The structural features of the group which I have enunciated above bring it into close proximity to the Australian genera *Cheiroplatys* and *Isodon*; but a reference to the diagnosis will show that it is abundantly distinct from them both. Unlike them, also, it appears, at any rate in one of the two

species described below, to have organs for slight stridulation; and its prothorax is apparently entire in both sexes (for as it is so in 15 *males* which are now before me, we may conclude *à fortiori* that this is equally the case in the opposite sex); and its anterior male tibiæ are not enlarged as in *Cheiroplatys*. The *Mellissii* are practically apterous, their wings being very small and rudimentary, and they seem to be eminently fossorial. In its simple (or unimpressed) prothorax the genus agrees with the European and African group *Pentodon*; but, apart from other differences, the members of the latter have their organs for stridulation exceedingly conspicuous, occupying, however, the central part only of the propygidium.

I have had much pleasure in retaining for the present genus the name proposed for it by Mr. Bates—in honour of J. C. Melliss, Esq., who has supplied the greater portion of the material for this memoir, and to whose researches we are consequently indebted for the additional light which has been thrown upon the small but highly interesting fauna of St. Helena.

21. *Mellissius eudoxus*, n. sp.

M. crassus, subquadrato-ovatus, rufo-piceus, nitidus; capite grosse ruguloso-punctato (fere scabroso), clypeo lato subtriangulari apice truncato et ibidem paulo recurvo lateribus anguste marginato; prothorace magno, convexo, grosse punctato, angulis anticis subporrectis acutiusculis, posticis rotundato-obtusis, ad latera rotundato, in medio vix subangulato, longe fulvo-ciliato; elytris subquadratis sed pone medium latiusculis, apice subtruncato-abbreviatis (angulis suturalibus paulo rotundatis), propygidium transversum sublæve (mucronibus valde transversis perpaucis solum in medio parcissime adspersum) omnino occultantibus, grosse submalleato-punctatis (punctis sat profundis et perpaucis quasi in sulcis obsoletissimis undulatis evanescentibus, præter sulcum suturalem rectum, obsolete dispositis); pedibus robustis, fossoriis, fulvo-pilosis.

Mas clypeo postice in medio obsolete tuberculato (vix cornuto).
Fœm. adhuc latet.
Long. corp. lin. 7–8½.

Scarabæus eudoxus, in Dej. Cat. 168 (1837).

Although small for the *Dynastidæ*, this species and the following one are the largest of the Lamellicorns which have hitherto been detected at St. Helena; and while both of them may be known by their thick, ovate-squarish bodies (they being rather widened posteriorly), their bald though sculptured upper surfaces, their strong fossorial ciliated legs, and their rufo-piceous colour, the *M. eudoxus* (which is, on the average, a trifle smaller than the *adumbratus*) is further conspicuous by

being the more shining and deeply punctured of the two, by its clypeus being wider, less margined at the sides, and less recurved at the tip, and by its elytra (some of the punctures of which have a faint tendency to arrange themselves in very obsolete, evanescent, longitudinal, flexuous grooves) being not only less *straightly* truncate (or more rounded-off separately) at their apex, but likewise concealing altogether the propygidium—which is *straight* and *transverse* (instead of being triangular), and so destitute of asperities (there being traces of only a very few transverse plaits, or short, broken file-like ridges, in the centre behind) that I am exceedingly doubtful whether the insect is able in reality to stridulate.

The *M. eudoxus* seems to be thoroughly indigenous to the island, and found principally in cultivated regions of a rather high altitude—according to Mr. Melliss, by whom the 12 examples from which the above diagnosis has been compiled were collected. It appears, however, to have been brought from St. Helena many years ago; for it is cited in Dejean's Catalogue under the name of *Scarabæus eudoxus*; and I am informed by Mr. C. O. Waterhouse that there are two specimens (likewise "unquestionably males") in the British Museum which had been placed aside as in all probability the type of some undefined group, and which are evidently conspecific with the present insect.

22. *Mellissius adumbratus*, n. sp.

M. crassus, subquadrato-ovatus, rufo-piceus, subopacus; capite inæqualiter punctato, fronte fere impunctata; clypeo triangulari apice truncato et valde recurvo, lateribus grosse marginato; prothorace magno, convexo, grosse sed leviter punctato, angulis anticis porrectis, acutis, posticis rotundato-obtusis, ad latera rotundato, in medio subangulato, fulvo-ciliato; elytris subquadratis sed pone medium latiusculis, apice recte truncato-abbreviatis (angulis suturalibus subrectis), propygidium subtriangulare (mucronibus transversis dense asperatum) vix occultantibus, grosse sed leviter submalleato-punctatis (punctis nullo modo in seriebus longitudinalibus, linea levi suturali excepta, dispositis); pedibus robustis, fossoriis, parce fulvo-pilosis.

Mas clypeo postice tuberculo medio magno conspicue cornuto.

Fœm. adhuc latet.

Long. corp. lin. 8–9½.

Amongst 15 examples, collected by Mr. Melliss and belonging to the present genus, there are three which are rather larger and nearly opake (the remainder being shining), and with the obscure frontal tubercle developed into a distinct corneous process, so that my first impression was that they

were evidently the opposite sex of the smaller form—though, at the same time, if males (as their comparatively armed clypeus would imply them to be), I should have been driven to the anomalous conclusion that the individuals of that particular sex were the larger and less brilliant of the two! and moreover, *on examination*, so many other characters presented themselves that I began to feel doubtful whether they were not, after all, specifically distinct. I therefore sent two of them to Mr. C. O. Waterhouse, of the British Museum, who has lately paid considerable attention to the Lamellicorns, and he is decidedly of opinion that they cannot be referred to the same species as the other examples which I forwarded to him. Indeed Mr. Waterhouse has shown by dissection that these two opake ones are males; and as I have myself since opened the abdomen of the third, as well as those of *eleven* out of the 12 brighter individuals, and find them all to be males likewise! there can be no longer any question that the two are positively distinct*.

Assuming therefore that the above opinion is correct (and it is difficult to see how it can be otherwise), the *M. adumbratus* recedes from the *eudoxus* in being more opake and (on the average) a little larger, in its sculpture being altogether shallower and less rough, in its frontal tubercle (though I can only vouch for the male sex) being very much more developed, in its clypeus being narrower, more coarsely margined at the sides and more recurved at the tip, in its anterior prothoracic angles being rather more porrect and acute, and in its elytra (*none* of the punctures of which have apparently any decided tendency to be longitudinally distributed in obsolete flexuous evanescent grooves) being more *straightly* truncate behind (or with the sutural angles less rounded-off), so as to expose a portion of the propygidium—which is itself more triangular (or pointed in the centre), instead of being separated from the pygidium by a *straight* suture, and is likewise roughened *all over* (very densely so in the middle) with short transverse plaits or tubercles (well separated from each other) which clearly are employed by the insect for the purposes of stridulation. This stridulating-power is very important; and I doubt whether the preceding species can stridulate (at any rate audibly so to us) at all; for *its* propygidium, which is entirely concealed by the apical portion of the elytra, is *comparatively* bright and unsculptured, an *extremely few* and distant transverse plaits in the hinder central region being alone traceable.

* The twelfth of these more polished examples was imperfect, and had lost its abdomen; but it differed in no respect, that I could perceive, from the rest.

Fam. 11. **Elateridæ.**

Genus 20. Heteroderes.

Latreille, Ann. de la Soc. Ent. de France, iii. 155 (1834).

23. *Heteroderes puncticollis*, n. sp.

H. elliptico-elongatus, subnitidus, niger pilisque brevibus demissis fulvis parce vestitus; capite prothoraceque dense et profunde punctatis punctulisque minutissimis intermediis irroratis, hoc magno, convexo, in medio coleopteris latiore, angulis posticis valde productis acutissimis et carinulis binis instructis, in disco postico obsolete canaliculato, basi transversim declivo sed in media parte ipsissima (pone scutellum) elevato; elytris grosse arguteque crenato-striatis, in interstitiis punctato-rugulosis; antennis, palpis pedibusque rufo-ferrugineis; tarsorum art° 3tio subtus late bilobo.

Long. corp. lin. 4¼.

I am informed by Mr. Janson that the two examples from which the above diagnosis has been compiled, and which Mr. Melliss captured at St. Helena, are well distinguished by the very deep and close punctation of their head and (largely developed) prothorax from all the species of *Heteroderes* with which he is acquainted. Amongst other characters, the species may be recognized by the much enlarged lobe, or lacinia, with which the underside of its third tarsal joint is furnished, by its almost black surface, which is sparingly clothed with a short decumbent fulvescent pile, and by its rufo-ferruginous limbs. It is a somewhat remarkable fact geographically that the only Elaterid hitherto observed at St. Helena should be a member of the genus which occurs also, in a single representative, at the Azores and Cape Verdes; whilst the equally rare Madeiran and Canarian exponents of that large department of the Coleoptera belong to a totally different group.

Fam. 12. **Cleridæ.**

Genus 21. Corynetes.

Herbst, Käf. iv. 148 (1791).

24. *Corynetes rufipes* *.

Anobium rufipes, Thunb., Nov. Ins. Spec. i. 10 (1781).
Corynetes rufipes, Woll., Col. Atl. 209 (1865).
—— ——, Id., Col. Hesp. 102 (1867).

The common European *C. rufipes*, as at Ascension and in the Canarian and Cape-Verde archipelagos, appears (judging

from three examples now before me which were captured by Mr. Melliss) to have established itself at St. Helena; but as it has equally become naturalized, through the medium of commerce, in most parts of the civilized world, it is of course totally unconnected with the real fauna of the island.

Fam. 13. Ptinidæ.

Genus 22. Gibbium.

Scopoli, Intr. ad Hist. Nat. 505 (1777).

25. *Gibbium scotias**.

Ptinus scotias, Fab., Spec. Ins. i. 74 (1831).
Gibbium scotias, Woll., Col. Atl. 214 (1865).

A single example of this European Ptinid is in the St.-Helena collection of Mr. Melliss; but the species, of course, is a mere importation, and might perhaps be found more plentifully if searched for in the warehouses and town. It appears, in like manner, to have become established at Madeira.

Fam. 14. Anobiadæ.

Genus 23. Anobium.

Fabricius, Syst. Ent. 62 (1775).

26. *Anobium velatum**.

Anobium velatum, Woll., Ins. Mad. 276, t. v. f. 3 (1854).
—— ——, Id., Cat. Mad. Col. 92 (1857).
—— ——, Id., Cat. Can. Col. 249 (1864).
—— ——, Id., Col. Atl. 226 (1865).

A single example of an *Anobium* which was taken by Mr. Melliss in St. Helena appears to me to be too close to the Madeiran *A. velatum* to admit of its being separated from that species, though perhaps its elytra are not *quite* so strongly punctate-striate. Its extremely elongated suberect pubescence renders it more in accordance with the *A. velatum* than with the Canarian *A. villosum* of Brullé, though in point of fact the two species are so intimately related that I cannot feel quite sure that they are more in reality than modifications of a single plastic form. If my conjecture, that in the more northern archipelagos these particular species are considerably attached to the old vine-trees, is correct, it is more than probable that the one now before me may have been accidentally imported into St. Helena.

27. *Anobium paniceum**.

Dermestes paniceus, Linn., Faun. Suec. 431 (1761).
Anobium paniceum, Woll., Col. Atl. 227 (1865).
—— ——, Id., Col. Hesp. 109 (1867).

I need scarcely add that the almost cosmopolitan *A. paniceum* (a few examples of which are amongst Mr. Melliss's insects from St. Helena) is a mere accidental importation into the island, and has no kind of connexion whatsoever with the true fauna, the presence of such species in any local list being merely dependent upon the amount of diligence with which the warehouses and stores may happen to have been searched. The *A. paniceum* has, in like manner, become established in the Azorean, Madeiran, Canarian, and Cape-Verde archipelagos.

28. *Anobium striatum**.

Anobium striatum, Oliv., Ent. ii. 16. 9 (1790).
—— ——, Woll., Col. Atl. 227 (1865).

Like the last species, the present common European *Anobium* has (judging from a few examples which were captured by Mr. Melliss) become established at St. Helena; but it has, of course, no more to do than that equally cosmopolitan insect with the original fauna of the island. It has been naturalized in like manner in the Azorean, Madeiran, and Canarian groups.

29. *Anobium confertum**, n. sp.?

A. cylindricum, fusco-nigrum, ubique minutissime et densissime subgranulato-punctatum pubeque brevi demissa cinerea vestitum; prothorace simplici, transverso, postice elytrorum latitudine, angulis anticis subrectis, posticis paulo magis rotundatis, ad latera subrecto subrecurvo ferrugineo; elytris obsolete longitudinaliter substriatis (sed punctis majoribus carentibus); antennis pedibusque inæqualiter piceo-ferrugineis, tarsis clarioribus.

Long. corp. lin. $1\frac{3}{4}$.

Having no information concerning the precise places of capture of Mr. Melliss's various Coleoptera, I cannot but look with suspicion upon a single example of an *Anobium* now before me, as having in all probability become introduced into the island and been found by him in some house or cultivated spot; yet, as it is well characterized by its very peculiar sculpture, and I cannot identify it with any member of the genus to which I have had access, I have thought it desirable to enunciate the species on the chance that it will be ascertained to have been undescribed. Apart from its cylindric but not very elongated outline, and (for an *Anobium*) rather dark hue, it may be known by its transverse prothorax, which has the

sides somewhat straight, slightly recurved, and ferruginous, by its fine and short (but not very dense) cinereo-sericeous pubescence, and by its entire surface being most minutely and closely punctulated, the punctures being so crowded together as to cause the surface to be dull and to appear at first sight to be alutaceous, or even coriaceous. Its elytra are obsoletely striated, but without any intermixture of larger punctures.

Fam. 15. **Bostrichidæ.**

Genus 24. Rhizopertha.

Stephens, Ill. Brit. Ent. iii. 254 (1830).

30. *Rhizopertha bifoveolata**.

Rhyzopertha bifoveolata, Woll., Ann. Nat. Hist. ii. 409 (1858).
Rhizopertha ——, Id., Col. Atl. 232 (1865).
—— ——, Id., Col. Hesp. 110 (1867).

I have little doubt that the present *Rhizopertha* has, like the *R. pusilla*, become naturalized in the island through the medium of commerce; and it is possible therefore that it may be ascertained eventually to have been described by some prior title to that which I myself proposed for it in 1858. Be this, however, as it may, it seems to be conspecific with the insect which was taken by Mr. M. Park "out of a cask of flour" at Madeira (in the Funchal custom-house), and likewise with an example which I captured in a quinta at Sta Catharina, in the interior of St. Iago, of the Cape Verdes. Unless I am much mistaken, there are many examples of it in the collection at the British Museum bearing labels which show how widely the insect has become disseminated, through human agencies, over distant parts of the civilized world.

31. *Rhizopertha pusilla**.

Synodendron pusillum, Fab., Ent. Syst. v. (Suppl.) 156 (1798).
Rhyzopertha pusilla, Steph., *loc. cit.* 354 (1830).
Rhizopertha ——, Woll., Col. Atl. 232 (1865).

Like the last species, the almost cosmopolitan *R. pusilla* appears (judging equally from examples of it which were taken by Mr. Melliss) to have become established in the warehouses and stores of St. Helena, just as it has in the Madeiran archipelago and elsewhere.

Fam. 16. **Tomicidæ.**

Genus 25. Tomicus.

Latreille, Hist. Nat. des Ins. iii. 203 (1802).

32. *Tomicus æmulus*, n. sp.

T. cylindricus, nitidus, nigro-piceus, pilisque longiusculis suberectis fulvescentibus parce obsitus; prothorace amplo, subalutaceo, postice evidenter punctulato, mox ante medium subnodoso-convexo, antice dilatato obtuse rotundato necnon mucronibus asperato; elytris leviter striato-punctatis punctulisque minoribus in interstitiis uniseriatim notatis, ad apicem retusis, parte perpendiculari dentibus sublateralibus duobus subæqualibus (sc. superiore et inferiore) ac perpaucis lateralibus minutissimis granuliformibus utrinque armata; antennis pedibusque testaceo-ferrugineis.

Long. corp. lin. $1\frac{1}{3}$.

The single specimen from which the above diagnosis has been drawn out, and which was captured at St. Helena by Mr. Melliss, has much the general appearance, at first sight, of the European *T. saxeseni* (which occurs likewise in the Azorean, Madeiran, and Canarian archipelagos); but a closer inspection will show not only that it is a little larger and more pilose, with its prothorax less alutaceous and more distinctly punctulated behind, but that its elytra are more retuse (or perpendicularly truncated) at the apex, and that each of them is armed with (in addition to smaller and granuliform ones) two robust acute spines. This latter character, apart from its less shining and more evidently punctulated prothorax and darker hue, will equally separate it from the *T. perforans*, a species closely resembling the *saxeseni*, and which has been found in the Madeiran and Cape-Verde archipelagos (where, however, in all probability it has become naturalized accidentally through human agencies). What the exact habit of the St.-Helena species may be, I cannot tell; but, if found in the higher districts of the island, at a distance from the towns, it is of course possible (though I should scarcely think likely) that it may be truly indigenous.

Fam. 17. **Hylesinidæ.**

Genus 26. Hylurgus.

Latreille, Gen. Crust. et Ins. ii. 274 (1807).

33. *Hylurgus ligniperda**.

Bostrichus ligniperda, Fab., Ent. Syst. i. ii. 367 (1792).
Hylurgus ligniperda, Woll., Col. Atl. 250 (1865).

As in the Azorean, Madeiran, and Canarian groups, the European *H. ligniperda* appears (judging from examples of it which were captured by Mr. Melliss) to have become naturalized at St. Helena; but as it is an insect which is eminently liable to accidental transmission along with trees of the pine family, its presence in even so remote an island may perhaps be accounted for.

[To be continued.]

XXXVII.—*On the Generic Identity of* Climaxodus *and* Janassa, *two Fossil Fishes related to the Rays.* By ALBANY HANCOCK, F.L.S., and THOMAS ATTHEY.

[Plate XII.]

WHEN the paper on the teeth of *Climaxodus linguæformis* was published*, it was not thought desirable to hazard an opinion as to their arrangement, or whether they were palatal or mandibular, or whether or not they belonged to both the upper and lower jaws. Since then we have obtained information that throws much light on the subject of these curious dental organs.

Mr. Howse having called our attention to some well-preserved specimens of the teeth of *Janassa bituminosa* of Münster†, from the Marl-slate, it was at once obvious, as pointed out by that gentleman, that they were closely related to those of *Climaxodus*—so closely, indeed, that they seem to be generically the same. The differences are only those of proportion, there being not a single character of importance to distinguish one from the other.

The teeth in both forms are depressed and elongated in the antero-posterior direction, and taper a little backwards; in front there is a wide concave margin, which, standing up like a scoop or dredging-bucket, is the cutting-edge; behind this the surface is covered with transverse imbricated ridges, forming the grinding or crushing portion; and further down, on a lower plane, the broad depressed root projects backwards and downwards for a considerable distance. In profile they present a sigmoid curve, the frontal scoop-like portion standing up in the direction of the oral cavity, the posterior or root extremity being turned downwards in the opposite direction.

The above description will do equally well for either *Climaxodus* or *Janassa*. Our Coal-measure species, however, *C. linguæformis*, Atthey, is considerably wider in proportion to its length, and the transverse imbricated ridges are stronger and much less numerous than they are in *Janassa bituminosa*. But *C. imbricatus*, M'Coy, from the Mountain Limestone, seems somewhat intermediate between the two; it is proportionally narrower, and the ridges are much finer than in *C. linguæformis*.

From these teeth alone the generic identity of all the three might be safely predicated; but there is further evidence in proof of the fact. *Climaxodus* and *Janassa* are both provided with two kinds of teeth. Those already indicated may be

* Annals of Nat. Hist. ser. 4. vol. ii. p. 321.

† Beiträge zur Petrefactenkunde, Heft 2. p. 38, tab. 15. f. 10–14.

looked upon as the principal or primary dental organs; the other kind or the secondary, in the two genera, resemble each other just as closely as do the primary; and it is interesting to find that these secondary teeth agree pretty closely with some of those included in the genus *Petalodus* of authors, only they are oblique.

In *Janassa* the association of these Petalodontoid teeth with the primary ones is too obvious to be called in question. In this form the two kinds are actually found arranged in order side by side. This is proved by the specimens already referred to and by Münster's excellent figures. The Petalodontoid form has likewise been obtained associated on the same slab with the primary teeth of *Climaxodus*. We have in our possession a small slab, not so large as the palm of the hand, on which there are seven primary teeth, three or four of which lie in their natural position. On this slab there are likewise three of the *Petalodontoid* form, two being in contact with the primary teeth, and apparently not far removed from their original position.

Six or seven other specimens of these secondary teeth have occurred scattered in the same shale in which the primary teeth are found. The secondary teeth have a certain resemblance generically to the primary teeth, and specifically they have characters in common with their respective primary teeth. Nevertheless they are scarcely generically distinguishable from the *Petalodus* of authors, though they are, as already stated, oblique.

Having said thus much with respect to the external characters of the teeth themselves in the two genera in question, we must now make some remarks about their arrangement in the mouth. In *Janassa* it is clearly demonstrated, both by the specimens and figures before alluded to, that the teeth are similarly arranged in both the upper and under jaws. In this genus they are placed in slightly arched transverse rows, the largest symmetrical primary tooth being situated on the median antero-posterior line, and projecting a little in advance of the others. On each side of this there are two similar teeth, but somewhat less, the outside one being twisted obliquely; the row is then terminated on either side by one of the Petalodontoid form. There are therefore seven teeth in each row, including both kinds—five primary, two secondary. Münster represents five or six such rows in close succession from back to front, the teeth and rows gradually diminishing in size forward. It is evident, then, that the arrangement of the buccal armature more closely resembles that of the Rays than the Cestracionts or Sharks; and, indeed, notwithstanding the difference in the teeth themselves, in their arrangement they

agree in a remarkable manner with those in *Myliobatis aquila* and *Zygobatis marginata*—a relationship which was recognized by Agassiz*. In the extraordinary dental apparatus of these two interesting forms the teeth or plates are placed crosswise on the anterior portion of the jaws in rows succeeding each other from back to front. The largest primary tooth is median: on each side of it there are two other primary teeth, both of which are small in the first genus, and only one in the second; all these teeth are charcterized by having six sides; and each row is flanked by a small or secondary tooth, distinguished by having only five sides. Thus it appears that each transverse row is composed of seven teeth, five of which may be looked upon as primary, two as secondary, arranged exactly as the teeth are in *Janassa*, and agreeing with them exactly in number.

Now it cannot be doubted that the disposition of the teeth is the same in *Climaxodus* as it is in *Janassa*; and in fact the specimens of the former, on the slab previously mentioned, verify this assertion when aided by the light derived from the latter. Alone perhaps these specimens might have justified the inference; but taken in connexion with what is known respecting *Janassa*, there can now be no hesitation upon the subject. Indeed the large, symmetrical, central teeth of two rows lie in proper order one over the other; and in contact with the upper one, and side by side with it, is the first lateral tooth in its exact true position; and a little further away, but almost touching it, is a secondary tooth, apparently belonging to this side. Overlying the first, lateral, primary tooth in front are the distorted remains of what seems to be the second lateral tooth. On the other side of the central tooth, and some little distance from it, is another primary tooth, which, from its oblique form, is undoubtedly the second lateral tooth of this side: it lies in juxtaposition to its flanking Petalodontoid tooth. All these teeth, with the exception of that last named, lie with their crowns uppermost, and belong to one row; the central tooth and the three lateral teeth of one side are all present, and lie nearly in their natural order; and the second lateral tooth and the secondary tooth of the other side are not far removed from their right position. So here we see a whole row of seven teeth complete, with the exception of one of the first lateral teeth. Two other small lateral teeth are on the same slab, and rest with their faces downwards, or in the opposite direction to those already spoken of. These belong apparently to the opposing jaw, and both lie in contact with the large central teeth; and one of them, as an opposing tooth,

* Poissons Fossiles, tome iii. p. 375.

occupies its correct position by the side of the upper central tooth. A third Petalodontoid tooth lies a little apart, and probably belongs to this jaw.

On another small slab recently obtained there is a fine specimen of a second lateral tooth associated with a secondary tooth.

From the above it appears that there is evidence enough to show that in *Climaxodus*, as in *Janassa*, the teeth are placed in transverse rows of seven teeth each, one being symmetrical and central, and six lateral, three on each side, the extreme lateral tooth on either side being Petalodontoid in form, that there are more rows than one, and that they are placed in both upper and under jaws. In fact it is quite evident, not only that the teeth in *Climaxodus* agree in external character with those in *Janassa*, but that they also agree with them in the mode of arrangement.

The minute structure of the teeth in the two so-called genera is very similar. In both, the centre of the tooth is composed of osteo-dentine, having branched anastomosing medullary canals, which are for the most part arranged lengthwise, and give off from their sides rather coarse tubules into the surrounding matter. The canals likewise send off comparatively small branches, which subdivide dichotomously as they approach the periphery of the tooth. Here many of them abut perpendicularly to the surface. The walls of these small branches assume the character of dentine, and the interstices between them are filled up with opaque white matter—probably cement; so that, by the unequal wear of these peripheral components, the surface of the tooth is always kept rough, having the granular and punctate appearance before spoken of. When quite fresh, there is a thin film of enamel covering the surface; but this seems to disappear rapidly with the use of the tooth.

The teeth of both *Climaxodus* and *Janassa* agree with the above general description; but in the latter the material appears more dense, and the cement is in greater abundance and is distributed more regularly than it is in *Climaxodus*; consequently it is found to assume a pretty regular reticulated appearance on the surface when a little worn down.

The generic identity, then, of *Climaxodus* and *Janassa* seems pretty certain; and as the latter was established many years (1832) before the former (1848), the genus *Climaxodus* must merge into that of *Janassa*. Ultimately, perhaps, *Petalodus* will be found to be more closely related than can at present be demonstrated; for it is not only in the Petalodontoid form that a resemblance is observed, but likewise in the primary teeth themselves, which show a remarkable similarity in general form to some of the *Petalodontes*.

Prof. M'Coy seems to think that his *Climaxodus imbricatus* is related to *Pœcilodus*. The relationship, however, with this genus seems to us to be remote, though it may have some characters in common with *Janassa*.

The bodies of these two fishes, *Janassa* and *Climaxodus*, were covered with shagreen. In the former it is beautifully preserved, the granules being highly polished, irregularly rounded, with one side a little flattened and obtusely denticulated. On the small slab, with numerous teeth of *Climaxodus*, already noticed, is a great quantity of granular matter, but the granules are much disturbed; a few, however, are well displayed, and show considerable resemblance to those of *Janassa*; but the denticulations at the side are produced into sharp points, and the surface is undulated.

Although *Climaxodus linguæformis* was pretty fully described in the paper already referred to, we will make, on the present occasion, some general remarks on the teeth in our possession, and also redescribe them.

The species cannot be considered common, though we have obtained eighteen primary teeth in the shale at Newsham and elsewhere, and eight of the secondary or Petalodontoid form. The largest of the former is $1\frac{3}{8}$ inch in length, including the root, and upwards of $\frac{7}{8}$ inch wide at the broadest part. The smaller are not more than $\frac{5}{8}$ inch long, and are oblique: these are the second primary teeth. There are three about this size in the collection. We have one, however, which, from its obliquity, is undoubtedly a lateral tooth, that is only $\frac{3}{8}$ inch in length. They are ovate, depressed, with the broad extremity anterior. The crown is upwards of two-thirds of the entire length, and is divided into two portions, anterior and posterior; the former is a wide, hollow, arched, scoop-like cutting-margin, which in some specimens is obscurely and minutely crenulated or denticulated, and is usually quite sharp: this portion occupies the anterior third of the crown; the posterior two-thirds is shield-formed, somewhat convex, with the point directed backwards and the sides evenly arched outwardly, This is the crushing- or grinding-surface, and is traversed by strong transverse undulated ridges imbricated forward, and divided by wide deep grooves. In fully developed specimens there are six such ridges; but the number varies, some having four, others five; and in the small, second lateral, oblique individuals there are only three. The ridges bend upwards at the sides, and usually arch a little forward at the centre, where they are most strongly undulated and sometimes deeply notched and angulated, roughened and granulated. But they vary considerably in these respects, some being almost smooth; and in one of our specimens all the ridges are comparatively

even, though here and there slight undulations are perceptible. From this comparatively smooth state there is every degree of undulation to the most rugged. In fact, the smoothness is very much owing to wear; and in such specimens this portion of the crown is generally much reduced in thickness. The form of the grinding division of the crown also varies considerably. We have said that the sides arch outwards; they are, however, not unfrequently quite straight; and when this is the case, and the anterior ridge is free from undulations, the area assumes the form of an equilateral triangle, with one of the angles directed backwards; in two or three specimens the area is even wider than long, with the lateral angles more acute than usual. In such individuals the scoop-like cutting-margin occupies half the crown. The root is a wide plate as broad as the tooth, and tapers slightly backwards; behind, it is rounded, convex above and concave below, and projects backwards on a lower plane, the crown being elevated above its upper surface.

The second primary or lateral oblique teeth are very inequilateral, one side being concave, the other convex; they have only three ridges, with the grooves very wide; the scoop-like cutting-margin is deep, oblique, and projects laterally on the concave side.

The largest Petalodontoid or secondary teeth are nearly $\frac{1}{5}$ inch wide and $\frac{3}{8}$ inch long; they are inequilateral and oblique, with one side concave, the other convex; they are depressed, and the crown is somewhat longer than the root; the former consists principally of a wide, sharp, hollow, scoop-like cutting-margin, which in fresh specimens is obscurely denticulated; the grinding-surface is very short, and is represented by only two transverse close-set delicate ridges immediately below the cutting-margin; the root tapers a little backwards, and is truncate.

From the character of the teeth above described, it may be inferred that the food of *Climaxodus* was composed of some soft material, notwithstanding the rather formidable appearance of the grinding- or crushing-surface. The cutting-edge of the scoop-like margin is sharp and thin, and does not seem calculated to seize hard and resistant bodies; and though it is frequently worn evenly down, its sharpness is maintained, often, apparently, by the wearing of the outside, as though the teeth had been overlapped by those that opposed them. And, moreover, the edge is not broken or chipped, as might be expected if it had rough work to perform, or came into contact with bony or shelly bodies. Neither are the ridges of the crushing-surface broken, but worn regularly, retaining their sharpness, though in a few instances they are much reduced

in height, as if they might even ultimately by long use entirely disappear.

At present only three species of *Janassa* are known, namely, *J. bituminosa*, Münster, from the Magnesian Limestone, *Climaxodus imbricatus*, M'Coy, from the Mountain Limestone, and *C. linguæformis*, Atthey, from the Coal-measures. Two species have been described by Mr. T. P. Barkas, under the respective names of *C. ovatus** and *C. vermiformis*†. The first is merely the variety with comparatively smooth ridges; the second is the true *C. linguæformis*, which latter was the name first used. Mr. Barkas's two names must therefore fall into the rank of synonyms‡.

Climaxodus imbricatus is somewhat intermediate between the Magnesian-Limestone species and that from the Coal-measures. The crown is narrower and more elongated than it is in *C. linguæformis*, and the ridges are more delicate, thus approximating to *Janassa bituminosa*. The anterior cutting-margin seems to have been deep; but the extreme border is wanting in M'Coy's figure; the root is also deficient. In the description in the 'British Palæozoic Fossils' the posterior extremity is mistaken for the anterior.

Mr. Howse will shortly publish in the 'Annals' a full description of the oral armature of *Janassa bituminosa* in continuation of this paper. It therefore only remains for us to state that the species will stand thus:—

JANASSA, 1832, Münster.

Climaxodus, 1848, M'Coy.

J. bituminosa, 1817, Schloth., sp.
J. imbricata, 1848, M'Coy, sp.
J. linguæformis, 1868, Atthey, sp.

* Geological Magazine, vol. v. p. 495. † *Ibid.* vol. vi. p. 381.

‡ *C. vermiformis* was not described till 1869. Mr. Atthey's description of *C. linguæformis* and that by Mr. Barkas of *C. ovatus* appeared simultaneously on the 1st of November 1868—the first in the 'Annals of Natural History,' the second in the 'Geological Magazine.' Mr. Atthey's paper, however, was read at the meeting of the Tyneside Naturalists' Field Club on the previous 9th of October (see Nat. Hist. Trans. of Northumberland and Durham, vol. iii. p. 295); so that the priority of *C. linguæformis* is clearly established. And, moreover, Mr. Atthey's specimens had been in his cabinet for many years, and were seen, or might have been seen, by all the palæontologists of the district. Mr. Barkas, indeed, says that he named and described *C. ovatus* in a lecture delivered by him, on the 28th of September, to the Mechanics' Institution of Newcastle-upon-Tyne. But, were this even strictly correct, we apprehend it would be no such publication of the species as to secure priority. Where, however, is the record either naming or describing at this time *C. ovatus*? We have searched for it in vain.

EXPLANATION OF PLATE XII.

Fig. 1. Two rows of teeth of *Janassa* (*C.*) *linguæformis*, a little over the natural size, arranged in order, the anterior row merely indicated: *a*, central primary tooth; *b*, root; *c*, first lateral primary tooth; *d*, second oblique ditto; *e*, secondary or Petalodontoid form; *f*, root of ditto.

Fig. 2. Primary tooth of *J. linguæformis*, smooth variety, slightly enlarged: *a*, scoop-like cutting-margin; *b*, grinding- or crushing-surface.

Fig. 3. Primary tooth of the same, a little enlarged; worn variety, intermediate between the smooth variety and those much undulated.

Fig. 4. Diagram of profile of primary tooth: *a*, scoop-like cutting-margin; *b*, crushing- or grinding-surface; *c*, root.

XXXVIII.—*Descriptions of five Birds and a Hare from Abyssinia.* By WILLIAM T. BLANFORD, F.G.S., C.M.Z.S.

Hirundo æthiopica, sp. nov.

H. similis *H. albigulari*, Strickl. (Contrib. to Ornith. 1849, pl. 17), sed conspicue minor et torque pectorali interrupta, gutture pectoreque rufescenti-lavatis.

Long. tota 5·25, al. 4·3, rect. med. 1·55, ext. 2·3, tarsi 0·45, rostr. a fr. 0·3, a rict. 0·5 poll. Angl.

Syn. *Cecropis rufifrons*, auct., ex Abyssinia.
Hirundo albigularis, Strickl. apud Heuglin, Ornithologie N. O. Africa's, p. 113 (nec Strickland, *l. c.*).

Hab. in Abyssinia septentrionali, et in Nubia (teste Heuglin).

Ruticilla (?) *fuscicaudata*, sp. nov.

R. supra brunnescenti-fusca, uropygio magis rufescente; remigibus rectricibusque fuscis, vix pallidiore marginatis; macula anteoculari nigrescente, albido circumdata; mento, gula, abdomineque medio sordide albis, pectore et hypochondriis cinerascentibus. Rostro pedibusque fuscis.

Long. tota circa 5·5 poll. Angl., al. 2·95, caud. 2·2, tars. 0·9, rostr. a fr. 0·45, a rict. 0·7.

Hab. in Abyssinia septentrionali.

The form of this bird resembles *Ruticilla*, the bill being similar and the tarsi smooth in front; but the sombre plumage rather resembles that of a *Sylvia*. Its nearest allies are *R.* (*Saxicola*) *familiaris*, Stephens, and *R.* (*Erythacus*) *sinuata*, Schlegel. The tail is somewhat rounded, and the wing is less pointed than in *Ruticilla*.

Phylloscopus habessinicus, sp. nov.

Ph. P. trochili similis, sed supra magis viridescens, subtus isabellinus vix flavescens, cauda longiore.

Long. al. 2·5, caud. 2·05, tars. 0·78, rostr. a fr. 0·36, a rict. 0·5, tota circa 4·5 poll. Angl.

Hab. in provincia Habessinica "Tigré" dicta.

Alauda prætermissa, sp. nov.

A. supra fusco-umbrina, capitis, colli postici interscapuliique plumis late et pallide rufescenti-marginatis; dorso posteriore magis cinerascente, vix striolato; superciliis et gastræo toto isabellinis; genis, colli lateribus pectoreque saturatioribus et fusco guttatis, regione parotica fuscescente, remigibus et tectricibus alarum umbrinis, primariis extus isabellino, secundariis cum tectricibus alarum rufo marginatis; remigibus omnibus intus versus basin rufo-fulvis; uropygio et rectricibus medianis rufescenti-umbrinis, exteris (pogoniis internis basin versus exceptis) et pogoniis externis secundarum rufo-isabellinis, cæteris cum partibus reliquis 4 externarum fumoso nigricantibus. Caput subcristatum; rostrum supra fuscum, subtus pallidum; pedes carnei.

Long. al. 3·9, caud. 2·15, tars. 1, ung. post. 0·45, rostr. a fr. 0·5, a rictu 0·75, tota circa 6·25 poll. Angl. Fœmina vix minor.

Hab. in provincia Habessinica "Tigré" dicta. Circa pagum Senafé frequentissimam inveni.

Crithagra flavivertex, sp. nov.

C. supra olivacea, obsolete fusco maculata, fronte late aurea, pileo summo paullatim olivascente; superciliis flavis, postice productis; loris fuscis; colli lateribus olivaceis, immaculatis; uropygio flavo; remigibus cum tectricibus alarum rectricibusque fuscis flavo marginatis, remigum marginibus internis pallidis; gastræo sordide flavo, olivascenti-lavato, crisso albescente; rostro brunneo, pedibus fuscis. Fœmina vix dilutius colorata.

Long. al. 3·15, caud. 2·15, tars. 0·6, rostr. a fr. 0·35, tota circa 5·25 poll. Angl.

Hab. in provincia Habessinica "Tigré" dicta.

Lepus tigrensis, sp. nov.

L. persimilis *L. saxatili*, sed minor, cauda breviore, plantarum pilis ferrugineis, haud umbrinis.

Long. capitis 4, corporis circa 13, caudæ cum pilis ad extremitatem 4, sine pilis 3, auris 5, lat. ejusdem 2·8; long. cranii 3·5, lat. 1·6, alt. 2·2; long. tibiæ 5·3, tarsi 4·5, radii 4·5, carpi 2·3 poll. Angl.

Syn. *Lepus abyssinicus*, Lefèbvre, Voyage in Abyssinie, Atlas, pl. 5. fig. 1 (nec Hempr. et Ehrenb.).

More complete descriptions, where necessary, and figures will be given in my forthcoming account of natural-history observations made during the Abyssinian expedition.

XXXIX.—*Descriptions of some new American Phyllopod Crustacea.* By A. E. Verrill*.

Artemia, Leach.

This interesting genus is remarkable for its habit of living and flourishing best in very saline and alkaline waters, such as the natural salt lakes of Egypt, Utah, &c., and the artificial brines formed by the evaporation of sea-water by exposure to the heat of the sun, as in England, France, and the West Indies.

The species first made known, *A. salina*, Leach (*Cancer salinus*, Linn.), was first described by Schlosser†, who found it in great profusion in the brines of Lymington, England. Linné indicates it also from the salt lakes of Siberia—perhaps a distinct species, and probably the same as that observed by Pallas‡ in great numbers in the Great Schimélée. More recently it has been described from the salterns of southern France, at Montpellier, &c.§ The genus has been found also in the lakes Goumphidieh, Amaruh, and Bédah in Egypt, which are reported to be both very saline and alkaline, their bottoms being "covered with a layer of crystals of carbonate of soda, sulphate of soda, and common salt," while the density of the water is stated as 1·255. The Egyptian species appears not to have been described as yet||. In the Antilles *A. Guil-*

* From Silliman's American Journal, being an abstract of a paper read before the American Association for the Advancement of Science, Salem, Mass., Aug. 1869.

† 'Observations périodiques sur la Physique, l'Histoire Naturelle et les Beaux-Arts,' par Gautier, 1756 (with figures). An extract from this is republished in 'Annales des Sciences Nat.' sér. 2. t. xiii. p. 226 (1840), in an elaborate description of the anatomy, development, habits, &c. of *Artemia salina*, by M. Joly, illustrated by two excellent plates of the female and young. M. Joly failed to observe the male among more than a thousand females, and therefore doubted whether the sexes were distinct, suggesting that the males very well described by Schlosser were only the young, although that author described them as clasping the females in the well-known manner; but he did not observe the actual copulation.

See also an article by Thomas Rackett, in Trans. Linn. Soc. of London, 1812, vol. xi. p. 205, pl. 14 (figures very bad); Thomson, Zoological Researches, No. 5. p. 105, t. 1 & 2; W. Baird, Nat. Hist. of the British Entomostraca, p. 61, tab. 2. figs. 2–4 (figures very good, but the specimens probably not full-grown).

‡ Voyage en différentes provinces de l'Empire de Russie, t. ii. p. 505 (tr. Joly).

§ M. Payen, "Note sur des Animaux qui colorent en rouge les marais salans," Ann. des Sci. Nat. 1836, sér. 2. t. vi. p. 219 (contains experiments on the effects caused by altering the composition and density of the water); also *op. cit.* 1838, t. x. p. 315; Joly, *op. cit.* 1840, t. xiii. p. 225 (see above); Milne-Edwards, Crustacés, t. iii. p. 369 (1840).

|| Audouin, Ann. des Sci. Nat. 1836, sér. 2. t. vi p. 230.

dingi, Thompson, occurs*. *A. Mulhausenii*, Edw. (Fischer, sp.) is found in Lake Loak, in the Crimea†. A few years ago Prof. Silliman presented to the Museum of Yale College a number of specimens of a new species, *A. monica*, V., which he collected in Mono Lake, California, where it occurs in great abundance associated with the larvæ of *Ephydra*‡. The water of this lake is very dense, and not only very saline but also so alkaline that it is said to be used for removing grease from clothing. I have been unable, however, to find any reliable analysis of this water. It is said to contain biborate of soda. Prof. Silliman informs me that the genus also occurs in Little Salt Lake. It occurs in great abundance in Great Salt Lake, Utah, as I am informed by Prof. D. C. Eaton, who obtained specimens there during the present summer; but these have not yet come to hand. The water of Great Salt Lake has usually been described by travellers as destitute of all life; but according to Prof. Eaton it contains not only an abundance of *Artemiæ*, but also various other small animals, insect-larvæ, &c. The density of the water is stated as 1·170, but doubtless varies much according to the season§. It yields, according to Dr. Gale, over 22 per cent. of solid matter‖, while the Syracuse Saline, one of the richest natural brines in the United States, contains but 19·16 per cent.¶ A few weeks ago, Mr. Oscar Harger discovered another new species, *A. gracilis*, V., near New Haven, under very peculiar circumstances. On the long wooden bridge across West River and the extensive salt-marsh on the West-Haven side, are placed large wooden tubs filled with water from various pools on the marsh, to be used in case of fire. By long exposure to the sun and air, the water in these becomes concentrated, and thus furnishes suitable stations for the rapid increase of *Artemiæ*. On examining the tubs on the

* Thompson, Zool. Researches, fasc. 7. pl. 1. figs. 11, 12.

† Edwards, Crustacés, t. iii. p. 370 (1840).

‡ Verrill, Proc. Boston Soc. Nat. Hist. 1866, vol. xi. p. 3 (the larvæ were wrongly referred to *Eristalis*); Packard, "On Insects inhabiting Salt-water," Proc. Essex Inst. 1869, vol. vi. p. 41.

§ The density of the water of the Atlantic Ocean is stated as 1·020, that of the Dea Sea 1·130 to 1·227.

‖ This solid matter, according to Dr. Gale (Silliman's Journal, ser. 2. vol. xvii. p. 129), has the following composition:—

Chloride of sodium	20·196
Sulphate of soda	1·834
Chloride of magnesium	0·252
Chloride of calcium	trace
	22·282

¶ For analyses of several of these brines, see Dana's 'System of Mineralogy,' p. 113.

1st of August, I found eight of them partly filled with water, in six of which the *Artemiæ* were found in abundance, though more numerous in one than in any of the others. In one tub, in which the water had a decidedly milky appearance, they were so abundant that hundreds could be obtained in a few minutes. The water in some of the other tubs containing them was of a reddish or brownish hue, or about the colour of weak tea. In two no *Artemiæ* could be seen; and in these the water appeared to have been more recently renewed. Search was made in the pools from which the water had been taken; but no *Artemiæ* were found, though doubtless from these places the progenitors of those inhabiting the tubs must have been taken. It is probable that in the pools they exist in very small numbers, being kept in check partly by various small fishes and other enemies, and partly by the unfavourable character of the water; while in the tubs the density of the water is more favourable for their rapid increase, and unfavourable or fatal to their enemies*. The water from the tubs, when examined with a high power of the microscope, was found to be filled with immense numbers of Infusoria of various kinds, such as Monads, Vibrios, and Bacteria, most of which were so small as to be distinguishable only as moving points with a $\frac{1}{8}$-inch objective.

In the salterns of France the *Artemiæ* are associated with immense numbers of a monad, usually bright red in colour, which has been named *Monas Dunalii* by Joly, who attributes to it the red colour which the brine assumes just before crystallization †, as also the red colour observed in the *Artemiæ*, which doubtless feed upon it as well as upon various other living Infusoria and dead animal and vegetable matter of various kinds ‡. The *Monas Dunalii* appears in abundance in the water having the density most favourable for *Artemia*, but increases in far greater proportion in the still denser, nearly or quite saturated brine in which *Artemia* does not live. The observations of Payen and Joly show that the *A. salina* of France can exist in waters varying in density from 4° to 20° Baumé, but that they flourish best in those that have a density of 10° to 15° §. According to Rackett, those of Lymington

* The density of the water in two of the tubs containing most *Artemiæ* was 1·065, equivalent to a brine containing 9·07 per cent. of salt. One of those tested was brownish, the other milky.

† "Recherches sur la Coloration en Rouge des Marais Salans Méditerranéens," par M. Joly (Ann. d. Sci. Nat. 1840, ser. 2. t. xiii. p. 266).

‡ According to M. Joly (*op. cit.* p. 262), a beetle, *Hydroporus salinus*, Joly, also inhabits the salterns where the water has a density of 6° or 7° Baumé, and preys upon the *Artemiæ*.

§ 4° to 20° Baumé is equivalent to a density of about 1·02 to 1·16;

do not live in the water which is undergoing the first stage of concentration, but only in the pans of concentrated brine containing about "a quarter of a pound of salt to the pint."

Our *A. gracilis* can exist without apparent inconvenience when the water in which they occur is diluted with an equal bulk of fresh water, as well as when it is much concentrated by evaporation. The water in which they were found varies in density from 1·060 to 1·065.

The genus is characterized by having eleven pairs of four-jointed branchial "feet" or fins along the sides of the body, the middle ones being the longest. Each joint of the "feet" bears flat branchial appendages, ciliated with sharp setæ, as in the other genera of the family. The abdomen is slender, six-jointed, the last joint long, terminated by two small projecting appendages, each bearing from six to ten plumose setæ. The first abdominal segment bears the external sexual organs of the male, and a short dilated ovigerous pouch in the female. In the male the head bears in front a pair of large three-jointed hooks or clasping-organs, each of which has on the inner side of its basal joint a small rounded appendage—a pair of slender antennæ just behind these, terminated by two or three minute setæ—a pair of pedunculated compound eyes—and a dark spot on the middle of the head, which is the remains of the single eye of the young. The mouth below is provided with a broad labrum, a pair of mandibles, two pairs of jaws, and a pair of lateral papillæ. In the female the head lacks the stout claspers, which are replaced by a pair of comparatively small, simple, horn-shaped organs.

Artemia gracilis, Verrill, sp. nov.

Body slender, in the male about ·3 inch long, in the female ·4. Claspers of the male relatively long and powerful; first joint thickened, with a distinct angle at the articulation on the outside, and a short, rounded, nearly semicircular process on the inside near the base, about its own diameter from the base; second joint broad, flattened, continuous with the third joint, strongly curved, outline nearly regularly convex on the outside, until near the middle it suddenly bends inward, forming an obtuse angle, beyond which the outline is concave to the last articulation, where it becomes again convex, forming on the last joint a slight rounded angle; the inner edge is nearly straight or but slightly concave to the last articulation, where

10° to 15°=1·075 to 1·117. A brine having a density of 1·020, which is nearly that of sea-water, contains about 2·766 per cent. of salt; one of 1·160 contains 21·219 per cent; one of 1·075 about 10·279 per cent.; 1·117 about 15·794 per cent.

there is a slight but distinct angle; last joint triangular, longer than broad, tapering to the acute, slightly excurved point. Antennæ slender, elongated, reaching beyond the first articulation of the claspers; terminal setæ minute. Abdomen slender, smooth; the terminal lobes small, longer than broad, broadly rounded at the end, slightly constricted at the base inside, each bearing usually seven or nine plumose setæ, the central ones much the longest. Ovigerous pouch of the female, when seen from below, flask-shaped, the neck extending backward and downward, short, thick, subcylindrical towards the end, the body of the "flask" short, thick, swollen laterally, broader than long, the sides terminating outwardly in a small, triangular, sharp tooth, sometimes showing a minute spine. This pouch is generally filled with numerous large brownish eggs.

Colour generally reddish, flesh-colour, or light greenish, translucent, the males usually lighter, greenish white, the intestines generally showing through as a dark reddish or greenish median line; eyes very dark brown or black; ovaries often whitish, along each side of the abdomen.

An adult male gives the following measurements:—

Distance between eyes 1·81 millim.; breadth of head ·76; length of eye-stalks ·62; length of first joint of the claspers ·91, its breadth ·72, breadth of its appendage ·18; length of second and third joints from outer edge of first articulation to the tip 2·48, greatest breadth ·86, breadth at last articulation ·72; length of last joint 1·05; length of last joint of abdomen, exclusive of appendages, 1·00, its breadth ·31; length of preceding joint ·42, its breadth ·37; length of terminal appendages ·21, breadth 0·96; length of longest setæ ·70.

Near New Haven, in tubs of water from salt marsh.

Artemia monica, Verrill, sp. nov.

Form similar to that of the preceding species, but a little larger and stouter. The largest female is 13 millim. (·51 inch) long, the abdomen being 6 millim.; and 5 millim. across the branchial feet in their natural, partly extended position. The largest male is 11·5 millim. (·45 inch) long, the abdomen being 6 millim. The claspers of the male are relatively stouter, the hook or outer two joints being much broader, more triangular, and less elongated. The inner edge of the first joint, as seen from below, is regularly convex, bearing the appendage on its most convex part and not so near the base as in *A. gracilis*, the distance being about twice the breadth of the organ, which is about as broad as long and regularly rounded. At the articulation the outer edge of the joint projects as a distinct

angle. The second and third joints together have a nearly triangular form, the breadth being about half the length; the outer edge is regularly rounded, shorter than in the preceding; it forms little more than a right angle with the front edge, which is nearly straight or a little concave, sometimes slightly convex at the last articulation, but not forming a distinct angle there; the inner edge of the hook is a little concave on the first joint, becoming convex at the last articulation, where there is a distinct but very obtuse angle. The last joint is almost regularly triangular, about as broad as long, tapering to an obtuse point, the inner edge being a little convex. The antennæ are very slender, and do not reach the first articulation of the claspers. The caudal appendages are smaller than in *A. gracilis*, and scarcely longer than broad, rounded at the end, terminated by nine or ten very slender plumose setæ. The egg-pouch of the female is broad flask-shaped, strongly convex in the middle below, the sides not forming such sharp angles as in *A. gracilis*.

The English specimens of *A. salina*, as figured by Baird, differ from both the preceding species in having longer, more curved, and sharper clasping-hooks, and the basal appendage more elongated; the egg-pouch, though badly figured, is of a very different form. The French specimens, as figured by Joly, appear like a distinct species, the egg-pouch being of a very different form, and the caudal appendages very much longer and larger than in either of our species, while Baird's figure represents them as very small; but his specimens appear to have been smaller, and may have been immature, for these species begin to breed before they are half grown. Whether the French species be distinct from the English can only be determined by additional examinations, especially of the male; for the male of the former appears not to have been figured hitherto.

BRANCHIPUS, Schäffer.

Branchipus, Schaffer, Elementa Entomologica, 1766 (type, *B. pisciformis* = (?) *B. stagnalis*, Linn. sp.).
Branchipus (pars), Lamarck, Latreille, Leach, Edwards.
Chirocephalus (pars), Dana (non Bénédict Prévost, 1803; Jurine, Thompson, Baird).

Under the name of *Branchipus* at least four generic groups have been confounded by various authors.

Branchipus should be restricted to the original species described by Schäffer and the allied species, of which *B. stagnalis* (Linn. sp.) is one, and if not identical with *B. pisciformis*, as is generally supposed, must be closely allied to it.

As thus restricted, the genus is characterized by the stout two-jointed claspers of the male, with or without a tooth near the base of the hook, the basal joint being swollen, by having a pair of simple appendages resembling antennæ between the bases of the claspers in front, by the large, thick, oval egg-pouches of the female, and, apparently, by the structure of the branchial organs. It includes *B. stagnalis*, *B. spinosus*, Edw., *B. vernalis*, Verrill, sp. nov., &c. Perhaps *B. paludosus*, Müller, also belongs here.

Branchinecta.—A group of species allied to these, but destitute of all appendages between the bases of the claspers of the male, which are more slender and simple—with a much elongated egg-pouch, having lateral lobes at the base—a more slender body, with more elongated branchial organs, the middle ones longest—and having, in general appearance, a much stronger resemblance to *Artemia*, probably constitutes another genus; but for the present we prefer to regard it as a subgenus of *Branchipus*.

For this group we propose the name *Branchinecta*. It includes two new arctic species, *B. grœnlandica* and *B. arctica*, and *B. ferox* (Edw., sp.) from near Odessa.

Heterobranchipus.—Dr. Lovén* has described a singular species, *B. cafer*, which appears worthy to constitute a distinct genus. It is remarkable on account of the very curious claspers of the male, which are very long, three-jointed, flexuous, the basal joint bearing a long cirrus externally and a lacerate tooth on the inner side of the base, the outer joint bifid, the internal part cirriform, the external one deeply bilobed. External male organs very long, slender, curved, outer portion serrate on the outer edge, with short setæ on the inner edge; egg-pouches long, slender, slightly enlarged and beaked at the end; branchiæ of a peculiar structure; front of head between the claspers with a short bimucronate rostrum.

H. cafer is from the marshes of Natal, South Africa.

Chirocephalus, Prévost, 1803.—This genus, established for *C. diaphanus*, is evidently very distinct from all the preceding. The typical species is large, stout, and remarkable for the singular appendages between the claspers of the male, on the front of the head. These consist of two long, ligulate, fleshy processes, serrated on each side, which coil in a spiral beneath the head, but when extended, as in copulation, reach beyond the claspers; attached to the outer side of each of these are four long processes strongly serrate on the inner edge, and near the base another large, broad, thin, subtriangular appen-

* Kongl. Vet. Akad. Handl. 1846, p. 433, tab. 5.

dage, its edges strongly serrate, especially in front, capable of folding up like a fan when not in use. The claspers have a much swollen basal joint, a strongly serrate tooth on the inside of the base of the second joint, which beyond this is slender and regularly curved. Egg-pouch long-oval, large and thick; caudal appendages large; male organs and branchiæ peculiar.

C. diaphanus, Prév., inhabits freshwater pools in France, Switzerland, and England. It is well described and figured in Baird's 'British Entomostraca,' p. 39, tab. 3 & 4.

Branchipus vernalis, Verrill, sp. nov.

Form rather stout, large; the full-grown females are 23 millim. (·91 inch) long, the abdomen being 14 millims.; and 6·5 millims. wide across the branchial organs in their natural position; breadth of head across the eyes 4 millims. A large male is 22 millims. (·87 inch) long, the body 12 millims.; the breadth of head across eyes 5 millims.; the entire length of claspers 8 millims. The claspers are very large and strong, the basal joint much swollen, with a soft integument, capable of retracting the basal portion of the second joint into itself by involution of its outer edge; the second joint is elongated, broad and stout at base, with an angle on the outside, from which it rapidly narrows by strongly concave outlines on each edge, but most on the outside; at the constricted portion, not far from the base, it bears a large, strong, very prominent, crooked, bluntly pointed tooth, which is directed inward and backward, not serrate on its outer side; beyond the tooth the rest of the joint is long and rather slender, curved outward and forward at base, having just beyond the tooth on the inside a distinct but very obtuse rounded angle, from which the outline slightly curves inward to near the tip, which is a little dilated and recurved. The basal portion, including the tooth, is retracted into the first joint in some specimens. On the front of the head, between the basal joints of the claspers, are two flat, short, lanceolate, ligulate, fleshy processes, with finely serrate edges, usually coiled down, but, when extended, scarcely more than half as long as the basal joint of the claspers. Antennæ small and very slender, tapering, reaching a little beyond the eyes. Caudal appendages long, rather narrow, slightly swollen at base, gradually tapering to the acute tips, and bearing along the sides, except at base, very numerous long plumose setæ. Egg-pouches short, broad-oval, nearly as wide as long, slightly three-lobed posteriorly, the central lobe largest, sides extended and largely adherent to the sides of the abdomen; length 4 millims., width

3·5. Body flesh-colour or pale red, the intestine darker red or greenish.

A large male gives the following measurements:—

Length of first joint of claspers 4·62 millims., diameter 2·40; length of second joint 4·14, breadth at base 1·90, at tooth ·72, in middle ·52; length of tooth ·90, its diameter ·33; length of caudal appendages 4, breadth at base ·33, in middle ·20; length of setæ 2; length of antennæ 3.

New Haven, in stagnant pools (J. D. Dana, D. C. Eaton, A. E. Verrill); Salem, Mass., April 19, 1859 (R. H. Wheatland, C. Cook, from Essex Institute); Cambridge, Mass. (A. E. Verrill).

This species differs widely from all the described species of Europe in the character of the claspers of the male and their appendages. *B. stagnalis* has a pair of long setiform organs between the claspers, and a tooth on the outer side of their second joint; *B. spinosus* resembles our species somewhat in the frontal appendages between the claspers, but lacks the conspicuous tooth at the base of the second joint of the latter. The shape of the egg-pouch in our species is also characteristic.

This is doubtless the species referred to by Dr. Gould under the name of *Branchipus stagnalis**. Dekay† copies the diagnosis of *B. stagnalis* (?) from a foreign work, and gives a figure of *Chirocephalus diaphanus*, copied apparently from Desmarest, pl. 56, which is itself a copy.

This species appears very early in spring, often in great numbers, in quiet pools. I have never seen it later than the middle of May; yet, since the individuals seen in early spring are full-grown, it might, doubtless, be found also in autumn.

Branchipus (*Branchinecta*) *arcticus*, Verrill, sp. nov.

Branchipus paludosus, Packard, Invertebrate Fauna of Labrador, in Mem. Boston Soc. Nat. Hist. i. p. 295 (non Muller).

Form slender, body short, abdomen elongated. A full-sized male is 20 millims. (·79 inch) long, exclusive of the claspers, the abdomen being 13 millims., the breadth between the eyes 3 millims. A female, 20 millims. long, with the abdomen 12 millims., has an egg-pouch 6·2 long. Branchial "feet" slender, elongated, the middle ones longest, 4–5 millims. long when extended. Claspers of the male rather long and slender; the basal joint is but little swollen, elongated, regularly curved, with a small tooth or prominent angle at the articulation on the inside, and on the inner side a row of numerous small,

* Invertebrata of Massachusetts, p. 339.

† Natural History of New York, Zoology, Part I. Crustacea, p. 63, pl. 9. fig. 36.

distinct, sharp teeth, extending from the articulation about half way to the base, and arranged somewhat obliquely; second joint slender, regularly curved, tapering to a blunt point, the inner edge minutely serrulate. Front simply curved, with no appendages. Antennæ slender, scarcely more than half the length of the basal joint of the claspers. Labrum long and narrow; mandibles stout, strongly curved, bluntly pointed. Caudal appendages slender lanceolate, rather small, with long slender setæ. Egg-pouch much elongated, slender, subcylindrical, beaked or slightly bilobed at the end, the upper or dorsal lobe longest, its basal portion with two small, rounded, lateral lobes.

A large male gives the following measurements:—

Breadth between outer extremity of eyes 3·46 millims.; diameter of eyes ·66; length of basal joint of claspers 1·66, breadth ·71; length of second joint 1·29, breadth at its base ·46; width of mandibles at middle ·66; length of caudal appendages ·96, breadth at base ·16; length of longest setæ ·84 to 1 millim.

Colour of preserved specimens pale reddish, with dark green intestine. Labrador, at "Indian Tickle," on the north shore of Invuctoke Inlet; abundant in a pool of fresh water (Dr. A. S. Packard).

Branchipus (*Branchinecta*) *grœnlandicus*, Verrill, sp. nov.

A little stouter than the last; the largest male is 17 millims. long, exclusive of claspers, the abdomen being 10 millims., including caudal appendages. Claspers similar to those of *B. arcticus*, but more elongated, the basal joint less curved, and the second joint longer, less regularly curved, tapering more quickly at base and consequently more attenuated beyond the middle, and with more slender tips, which are nearly straight. The tooth on the inside of the first joint is rather more prominent, but the teeth of the row along the inside are similar. Caudal appendages stouter, tapering more rapidly. External male organs slender, curved outward, swollen at base. The largest female is not mature, and the egg-pouch contains no eggs; it is small, slender, elongated, subcylindrical, beaked at the end.

The largest male gives the following measurements:—

Breadth between eyes 3·20 millims.; length of basal joint of claspers 2·81, breadth ·95; length of second joint 2·24, its breadth at base ·76; length of caudal appendages ·86, width at base ·24; length of setæ ·76.

Greenland (Dr. Chr. Lütken). From the University Zoological Museum, Copenhagen.

Of this species I have seen but four specimens, which were

sent to Dr. A. S. Packard by Dr. Lütken, under the name of *B. paludosus*, Müller. The latter appears to be quite distinct, to judge from the figures; it is represented as having appendages between the claspers, and very slender, linear caudal appendages. In the form of the egg-pouch and the serration of the first joint of the claspers it is similar.

This species is very closely allied to *B. arcticus*; and when a larger series of specimens can be examined, it may prove to be only a local variety; but the specimens studied show differences that seem to warrant their separation.

XL.—*On some British Freshwater Shells.* By J. Gwyn Jeffreys, F.R.S.

I lately received from Mr. Thomas Rogers, an active and enthusiastic naturalist at Manchester, specimens of a small *Planorbis*, for my opinion. He discovered them in the Bolton Canal. They proved to belong to a species new to Europe, viz. the *P. dilatatus* of Gould (*P. lens*, Lea), which was originally found near Cincinnati, and inhabits an extensive tract of the United States. The shell is about the same size as *P. nautileus*, which may be considered its nearest ally; but it has one whorl less, the periphery is angulated, the underside is remarkably gibbous, the mouth is very large, squarish, and scarcely oblique, the outer lip is expanded ("so as to make it trumpet-shaped," Gould), and the umbilicus is abruptly contracted, small, and deep. Some of the Manchester specimens are more or less distinctly, though microscopically, striated in the direction of the spire. The following is a description of the animal or soft parts :—

Body dark grey, often with a slight orange tint, closely and minutely speckled with flake-white: *mantle* thick, lining the mouth of the shell: *head* large and tumid: *mouth* furnished with broad lobular lips: *tentacles* cylindrical and extensile, widely diverging, broad and triangular at the base; the sheath or outer part is gelatinous, and the core or inner part is of a much darker colour and apparently greater consistence; tips rounded: *eyes* sessile, on the inner base of the tentacles: *foot* oblong, squarish in front, and bluntly pointed behind: *verge* curved, on the left-hand or umbilical side of the shell. The spawn is arranged in an irregular mass containing about a dozen membranous capsules, each of which has a yellowish yolk or vitellus in the centre.

It is active, and occasionally creeps, like many other aquatic

Gastropods, on the under surface of the water, with its shell downwards.

Inhabits the Bolton and Gorton Canals at Manchester.

Suspecting that this American species had been introduced into our canals through the cotton-mills, I wrote to Mr. Rogers for information; and he tells me that in one habitat (and probably in the other also) the waste from the first process or "blowing-machine" is discharged close to that part of the canal where the *Planorbis* occurs. As the best cotton is cultivated in river-bottoms, and the crop, when picked, is spread out and dried, nothing is more likely than that it should take up either the *Planorbis* or its eggs; and these could be transported alive to any distance. The vitality of *Planorbis*, and its capability of enduring considerable changes of temperature, may be inferred from the habit which certain species are known to possess of closing the mouth of the shell in summer (when the shallow pieces of water in which they live are dried up) with an epiphragm or membranous lid, to exclude the heat and prevent the evaporation of the natural moisture. Thus protected, they keep alive for weeks, and even months, until the return of the rainy season.

In connexion with the foregoing, I would suggest that *Sphærium ovale* may have been introduced in the same or some other way from the United States. That species also inhabits the canals near Manchester, and may be the *Cyclas transversa* of Say. It has long been known in this country. I have a specimen which was in Dr. Turton's collection of British shells more than forty years ago.

I have written to Mr. Anthony, of Cambridge, Mass., one of the leading conchologists in the United States, for information as to the range of distribution there of both these species, and especially as to whether they, or either of them, inhabit the cotton-growing districts.

Several species of land-shells (e. g. *Zonites cellarius* and *Helix nemoralis*, var. *hortensis*), and perhaps of freshwater shells also, are supposed to have been introduced into North America from Europe by the agency of man, and are now thoroughly acclimatized in the former continent.

XLI.—*Notes on Seals* (Phocidæ) *and the Changes in the Form of their Lower Jaw during Growth.* By Dr. J. E. Gray, F.R.S. &c.

One of the most important studies of zoologists has been the examination and comparison of the differences in the colour

and structure of fur or feathers, and other external characters, that occur during the growth of animals, and the differences that take place in the outer appearance of the same animals in the different seasons. Now that so much attention is paid to the characters afforded by the skull, teeth, and other parts of the skeleton to distinguish the recent species, and to separate them from the allied animals whose remains are found in a fossil state, it becomes most important that great attention should be paid to the variation which takes place in the form of the different bones during the progress of the animals towards maturity or old age, and the variation that occurs in the different bones of the skeleton of the same species, or in the skeletons of allied species.

Having the importance of this study always before my eyes, I send you an account of a difference which I have recently observed in the form of the lower jaws of Seals during the growth of the animals.

The British Museum has lately received the skulls and skeletons of some large European Seals (I believe, from the Baltic) which were exhibited in the Zoological Gardens as the "Ringed Seal, *Phoca annellata*." They are very interesting as showing the difference in the form of the front part of the lower edge of the lower jaw which occurs during the growth of these animals.

Unfortunately almost all the skulls of the European Seals previously in the Museum collection are from young animals. The examination and comparison of these skulls of young animals, and the comparison of these with the skulls of the adult Seals received from Mr. Wood from Vancouver's Island, which I described under the name of *Halicyon Richardii*, induced me to believe that the form of the lower edge of the "lower jaw afforded very good characters for the distinction of the species." (See Proc. Zool. Soc. 1864, p. 30, and Cat. of Seals and Whales in the Brit. Mus. 1865, p. 30.)

The skulls of older specimens of *Callocephalus vitulinus* in the British Museum show that, though the strength and general form of the lower jaw, and especially the position of the angle in the lower edge as compared with the condyle, do afford good specific and even generic characters, the form of the inner side of the lower edge, on which I have been inclined to place reliance, varies considerably according to the age of the specimens. In the young specimen, for example, the inner edge of the front of the lower jaw is dilated and produced inwards, so as to form a protection to the front of the gullet; but as the animal increases in age, this dilatation

appears to diminish, or, rather, not to be extended as the jaw becomes thicker in front, which it does in the adult animal.

In the skull of the adult animal, it no longer forms a projection on the inner side of the lower edge of the jaw; the jaw being much thicker and more substantial, it forms only a slightly marked keel on the middle of the lower surface of the jaw, separated from the rest of the jaw by a slight groove on its inner side.

The extent of this dilatation in the young animal affords a character for the separation of the young animals of the different species. Thus, in the young *Callocephalus vitulinus*, the dilatation only extends to a line even with the third lower grinder; in *Pagomys fœtidus* it extends to a line even with the fifth or last lower grinder, and it is wider and more developed in the latter than the former. The ramus of the lower jaw in this genus is so oblique and directed backwards, that the angle on the hinder part of the lower edge is in a line considerably in front of the upper part of the compressed process in front of the condyle. (See Proc. Zool. Soc. 1864, p. 29, f. 3; Cat. Seals & Whales Brit. Mus. 1865, p. 28, f. *c*.)

Though it is impossible to determine the species of Seals with any certainty without the more careful examination and comparison of the skulls, yet it is by no means impossible that two or more specimens which are very distinct in external characters, manner, habit, voice, &c. may have very similar skulls, or skulls so alike that, when they are compared in a museum, they may be regarded only as individual or accidental variations of the same species.

The form of the hinder edge of the palate seems to be less liable to variation in the Earless Seals (*Phocidæ*) than in the Eared Seals or Sea-bears, at least as far as I have been able to observe in the skulls of these Seals in the British-Museum and other collections.

The earless Seals (*Phocidæ*) are distinguished from the other Pinnipedia thus:—A small perforation for the ear, without an external conch. Eyes large. The feet hairy, more or less clawed; fingers short, curved, webbed, clawed, forming a well-formed webbed foot; the toes unequal, the three middle shorter, forming a broad triangular foot when expanded and an elongated paddle when contracted; the palm and soles hairy. The hind limbs are folded together, and are produced outwards behind the body, when on land or in the water. Walking on land by the action of the abdominal muscles. Testicles enclosed in the body. Skull and skeleton very distinct from those of Otariadæ in external form; skull without any, or only a rudimentary postorbital process.

Section I. *Cutting-teeth* $\frac{6}{4}$, *lower conical; hind toes clawed.*

Tribe 1. Phocina. The front grinder in each jaw single-, not, as the rest, two-rooted. Head narrow in front. Muffle bald, callous, and with a central erect groove between the nostrils.

i. Muzzle broad, whiskers smooth; third finger longest. Skull: face large, forehead convex, palate arched behind. Lower jaw strong, ramiserial angle under the front of the condyle; teeth small, compressed, far apart.

Phoca, Gray, Cat. S. & W. 31, f. 10.

ii. Muzzle conical, whiskers waved; first finger longest. Skull tapering in front; forehead flat; face small.

* Lower jaw strong, ramiserial angle in a line rather in front of the condyle; teeth thick, conical, lobed.

Pagophilus, Gray, *ibid.* 25, f. 8. Hinder end of palate truncated.

Halicyon, Gray, *ibid.* 27, f. 9. Hinder end of palate arched.

Callocephalus, Gray, *ibid.* 21, f. 7. Hinder end of palate angular.

** Lower jaw weak, ramus sloping, angle in front of the process in front of the condyle; teeth small, separate, compressed and lobed, especially in the lower jaw.

Pagomys, Gray, *ibid.* 22. Hinder end of palate angular.

Tribe 2. Halichœrina. The grinders all single-rooted, except the two hinder of the upper and the hindmost of the lower jaw. Head broad, square in front; muzzle large, truncate; muffle hairy to the edge and between the nostrils; whiskers waved.

Halichœrus, Gray, *ibid.* 33, f. 11. North Sea.

Section II. *Cutting-teeth* $\frac{4}{4}$. *Muffle hairy to the edge and between the nostrils.*

Tribe 3. Monachina. Lower cutting-teeth notched on the inner side; the first grinder in each jaw single-rooted, the rest two-rooted.

Monachus, Gray, *ibid.* 18, f. 6.

Tribe 4. Lobodontina. Cutting-teeth concave; grinders deeply and immensely lobed; the first, second, and third upper and the first lower grinder one-rooted, the rest two-rooted. Hinder claw small. Muffle hairy.

Lobodon, Gray, *ibid.* 9, f. 2 (skull). Lower jaw with angle beneath the condyles. Antarctic Sea.

Tribe 5. STENORHYNCHINA. Cutting-teeth conical; grinders more or less three-lobed, two front in each jaw single-rooted, the rest two-rooted. Muffle hairy to the edge and between the nostrils. Hind feet clawless. Antarctic Seas and South Pacific?

Stenorhynchus, Gray, *ibid.* 15, f. 5. Lower jaw strong, ramus erect; grinders with three cylindrical elongate lobes.

Ommatophoca, Gray, *ibid.* 33, f. 4. Lower jaw slender in front; grinders small, compressed, with a central incurved lobe and a very small one on each side.

Leptonyx, Gray, *ibid.* 11, f. 3. Lower jaw weak, ramus shelving backwards; grinders subcompressed, with small central and smaller posterior lobes.

Tribe 6. CYSTOPHORINA, Gray, *ibid.* 38. Lower cutting-teeth conical, unequal; grinders with small plaited crowns and large swollen simple roots. Muffle hairy, of male produced or inflated; whiskers waved.

Morunga, Gray, *ibid.* 38, f. 13. Nose of male produced into a trunk. Antarctic and North Pacific Oceans.

Cystophora, Gray, *ibid.* 40, f. 14. Nose of male with an inflated crest. North and, perhaps, South Atlantic.

XLII.—*On some points in the History and Relations of the Wasp* (Vespa vulgaris) *and* Rhipiphorus paradoxus. By ANDREW MURRAY, F.L.S.

EVERY entomologist knows that *Rhipiphorus paradoxus* undergoes its transformations in the nest of *Vespa vulgaris* (the common wasp which makes its nest underground). But in what capacity it is present there, and what are its relations to its hosts, are still matters of dispute. Is it as a robber and a murderer that it appears, or simply as a guest? and if as a guest, is it as a cuckoo-guest usurping the place of the genuine offspring of its hosts, or as an inoffensive changeling innocently imposed on the unconscious parents, and merely filling up a place which (from the wasp point of view) might have been better supplied had it been left empty?

In support of the more truculent hypothesis, Mr. Stone records, in the 'Entomologist's Monthly Magazine' (i. p. 118), how he found a larva of *Rhipiphorus* "sticking to the larva of

a wasp," which it devoured, except skin and mandibles, in forty-eight hours. The milder supposition had the support of Latreille and most subsequent authors (at any rate prior to Mr. Stone's observation), who, although they always spoke in somewhat doubtful tones, yet on the whole inclined to the opinion that the *Rhipiphori* were bred by the wasps under the mistaken belief that they were their own progeny.

This still seems to me to be the true explanation; and it is supported by some observations which I have recently had the opportunity of making, through the kindness of Miss Eleanor Ormerod, Sedbury Park, Chepstow, a lady with more of the true spirit and genius of a naturalist than any other whom it has been my fortune to encounter. She has been kind enough to assist the Horticultural Society in an attempt they are now making to form a collection of what may be called Economic Entomology—a task for which their connexions give them peculiar advantages, and of which the commencement may be seen housed in the South-Kensington Museum.

The charge of the formation of this collection having been entrusted by the Society to me, Miss Eleanor Ormerod's contributions have consequently passed through my hands, and I have had the advantage of profiting by her talents for observation. Among numerous other illustrations, she lately sent a large wasps' nest, containing *Rhipiphori*; and it is the examination of this, and the picking out the larvæ and pupæ from the cells to fit it for preservation, which has supplied the facts I am about to mention.

In France the knowing mode of procuring specimens of *Rhipiphori*, as expounded to me long ago by my old friend M. Chevrolat, is to note in summer the *locale* of a large wasps' nest, and to return to it in winter, and then examine it. Miss Ormerod's dealings with the wasps are simpler, bolder, and, as will be presently seen, more instructive. The process will be found detailed more at length in her brother Dr. Ormerod's little book on wasps. Enveloping her head in a gauze bag, which is made to stand out from her face by a broad-brimmed hat, and is tied tightly round the neck, protecting her hands by long and stout gloves tied tightly above the wrists, she fearlessly handles, rifles, or removes the largest and most formidable nest. Her subsequent perseverance and patience are not behind her courage; she tells me that she has picked out 3000 larvæ and pupæ from the nest which is the subject of these observations; and the reader will presently see that the intelligence with which every point of interest was observed and noted during the process is equally remarkable.

The nest which supplied our material in the present instance

was a very large one, containing six or seven large combs more than a foot in diameter. It was built in the ground, partly in a rough stone drain, and unusually deep and distant from the opening, being more than a yard from it, and fully a foot beneath the surface. The soil was very hard, so much so that it took a strong labourer nearly half an hour's work to get at it.

When the nest was raised out of its hole, after asphyxiating its inhabitants, a fully formed male and female *Rhipiphorus* were found, one lying dead among wasps at the bottom of the nest, and the other gone head foremost into one of the great cells (queens' cells) at the bottom.

No other *Rhipiphori* were found by Miss E. Ormerod in the lower or last-made tiers of comb—that is, in those composed of large cells (for male and female larvæ); all except the lowest two tiers of comb were composed of small or worker cells. She found no larvæ, but pupæ in every stage, from that almost resembling the larva in whiteness and form to the perfect insect, able, when the cap or seal of the cell was removed, to run out with such speed and dash down a neighbouring cell, that she could scarcely distinguish what it was. She mentions incidentally the stages she remarked in development were white, white with the black showing on the thorax, and coloured before the wings had developed. She noticed, too, that, in coming out, the pupæ did not cut the lid or cap nicely round, as the wasps do, but thrust their heads roughly through the middle of it, apparently only getting out by forcing their way slowly through the torn hole; but she did not see any specimen complete the operation of freeing itself.

All the specimens in the nest in question were of the common size; but two or three varied from the others in colour, as in having the abdomen black (or black with light rings) instead of yellow. From another nest, however, she took one of the large size mentioned by Prof. Westwood, in his 'Introduction to Entomology,' vol. i. p. 294, on Mr. Hope's authority, as being found only in the cells of the female wasps; the comb she took it from was full of nearly full-grown females of *Vespa vulgaris*.

Having picked the combs of the large nest pretty clean, Miss E. Ormerod sent it on to me, kindly leaving a portion of the cells unopened in all the combs, for me to have an opportunity of verifying her observations for myself. I found about fifty specimens of *Rhipiphorus* ready to come out, alive, not quite so active as described; but that was, no doubt, due to their not having reached their full term. I also found about a dozen pupæ less advanced. I did not distinguish any

difference in the proportions of the sexes in the combs which I examined: male and female seemed to come indifferently; and the cells in which they were placed seemed to be scattered indiscriminately over the combs in which they occurred, perhaps occurring a little more frequently towards the outer margin than the centre; and in the case of those near the outer margin, more of them seemed to lie near to each other. As already said, there were none in the queens' cells; but the greater part of them were as yet unoccupied.

In three instances I found two pupæ in the same cell, a wasp-pupa and a *Rhipiphorus*-pupa—a fact which seems to me to be conclusive against the idea of the one feeding on the other. They must have been hatched in the same cell, bred lovingly as larvæ in the same cell, and undergone their metamorphoses in the same cell. Both the pupæ in two of these instances are preserved in a phial of Canada balsam, and exhibited, along with the combs and sketches of their position, in the South-Kensington Museum. Their position was remarkable. In one of them the pupa of the wasp was next the mouth of the cell, but with its tail to the mouth, and the pupa of the *Rhipiphorus* further in, with its tail to the base of the cell, their heads thus meeting. The usual black saucer of droppings of the wasp-pupa was at the mouth of the cell. I shall return to it presently, but in the meantime stick to the *Rhipiphori*. Both pupæ were sufficiently developed, rather small and stunted perhaps, especially the *Rhipiphorus*, but all right, no lesion or distortion. In the next case there was distortion: the larva of the *Rhipiphorus* was uppermost, and I think (although I am not quite certain) that its head was towards the mouth of the cell. Its tail, or, to speak with absolute caution, its inner end (be it head or tail) rested on the head of the pupa of the wasp; and at first I thought the head of the latter had been eaten away, but, on closer examination, I found that it had merely been squeezed out of shape, leaving a discoloured depression where it should have been, and had dwindled into an unnatural small lump, in which, however, the eyes and mouth are to be distinguished. It was obviously nothing but the result of protracted pressure, which had begun to end in the destruction of the parts exposed to it. In the third case, the wasp-pupa was next the mouth of the cell, with its black deposit in the lid (preserved *in situ* at South Kensington), and the *Rhipiphorus* at the bottom in its natural position. Both were unhurt, but rather small.

On examining the bottoms of the cells from which the *Rhipiphori* were taken (I mean those which had a cell to themselves) I found more than once the débris of the skin of a

wasp's larva, easily recognizable by its mandibles. At first sight this might seem to indicate that the *Rhipiphorus* had consumed a previous tenant of the cell, and recalled to my mind the way in which Mr. Stone speaks of his wasp-larva being devoured by a *Rhipiphorus*-larva, except "skin and mandibles," in forty-eight hours. But if any one will search the cells of the wasp-pupæ, and still more those of the hornet, they will constantly find the same thing, a shred of skin and mandibles, the skin of the mandibles being particularly noticeable in consequence of its greater strength, higher colour, and definite form. It is plainly the cast skin of the larva. It has all the look of a cast skin (every entomologist will recognize my meaning); and its occurrence in cells inhabited by *Rhipiphorus* is simply due to the *Rhipiphorus* having taken up its abode in a cell formerly inhabited by a wasp-pupa. Mr. Stone's observation, as it appears to me, must rest on a mistake in some way arising out of such a cast skin. The wasps, indeed, are said to clear out the cells which have been inhabited previously, before laying their eggs in them again. I have seen no indication of any such cleaning or redding up for a new tenant. The dégâts at the bottom are left all standing, and, from the size of this dung-heap (especially in the hornets' cells, where the quantity is naturally much greater), it is not difficult to distinguish those cells which have had more than one tenant from those which have been used only once. The silvery lining of the walls is all left, and, what we have specially to do with also, the cast skin of the previous larva. It is constantly to be seen in the cells; and that we do not see it always may be due to its sometimes decaying away or getting covered with additional rejectamenta; for it is plain that the digestive operations will continue after the insect has ceased to feed, and shut itself up, until the contents of its stomach are all voided. This, moreover, is proved by the black deposit having been found at the mouth of the cell in the case of the reversed specimen first above noticed. If it had been deposited prior to sealing up, it must have fallen out, not to speak of the barrier it would be to the larva in spinning itself up. The eggs of the wasps are not deposited, as by the bees, at the bottom of the cell, but about a third of the way up, so that this débris does not interfere with them.

In picking out some specimens of cells with eggs attached, Miss Eleanor Ormerod observed some with two eggs in the same cell. She sent me some of these combs, in which a tolerably large proportion (about four out of a score) had two eggs, either both in the state of eggs, or a young larva at the bottom and an egg not yet hatched adhering to the

angle of the cell higher up. I have tried my best to find a difference between the two eggs, but without success. I am not sufficiently acquainted with the economy of wasps and bees to know whether the queens often or ever commit the mistake of laying two eggs in the same cell: it may happen sometimes; but when it does happen, one would expect to find the mistake at long and wide intervals, not in a cluster or near each other, unless, indeed, we are to suppose that the queen only makes the mistake when she is in a stupid or absent frame of mind; for then the mistakes should all be near each other. This, however, seems less likely, because the exercise of instinct is not like that of pure mental effort. A man's instinct will lead him right when his reasoning fails him. Every one must be able to recall to his mind some time or other when he has instinctively found his way home although his mind has been so preoccupied as to take no note of external objects; and absence of mind would therefore be immaterial to an insect engaged on an operation of instinct. Now in the combs containing eggs the doubly employed cells were located near each other; and that I should be inclined to regard as a *primâ facie* presumption that one of the eggs was not that of the wasp, but of *Rhipiphorus*.

Should that be so, the points of resemblance in the economy of the *Rhipiphorus* to that of the wasp would become very striking. We should have:—

1. The egg of the same size, texture, shape, and transparency in both. (I am not quite positive about the enclosed undeveloped larva being quite the same. I have thought that in Canada balsam, which makes the shell transparent, the one seemed longer than the other; but this may have been due to state of advancement or imperfect observation.)

2. We should have the egg attached in the same way, at the same height in the cell, and in the same angle as it is placed by the wasps.

3. The larvæ must feed on the same food as the wasp-larvæ, and deposit similar black droppings; for these are found in the *Rhipiphori*-cells as well as in the wasps', and are undistinguishable from them, consisting of débris of digested insects, which might with care be often identified. In the hornet, where the fragments are larger, the identification of most of them can be made without much difficulty. Miss Eleanor Ormerod shrewdly remarks to me, however, that she has observed that, unlike the wasps, the dead pupæ of the *Rhipiphorus* keep well in their cells, and that this may be due to a difference of food. But we must remember that their texture is naturally harder and drier.

Lastly, it must pass into the pupa-state, and spin a cap or lid to the cell, and the membranaceous, thin, silvery, shiny-looking lining to the cell, all in the same way as the wasp-pupa; for the lids of the *Rhipiphori*-cells are identical with those of the wasp-cells and undistinguishable from them. I here assume, as I think is the general belief, that this lining and lid are spun by the pupa, although it does not present itself to my mind as absolutely free from difficulties. I am not a hymenopterist; that is, I do not make a specialty of that branch of entomology; I therefore may without loss of credit indulge in wonder not allowed to the better-informed specialist at some of the things which to my unsophisticated mind appear amazing and puzzling, but which to him are hackneyed and trite. The lid of these wasp-cells and the manner of their formation is one of these things. The authorities say the pupæ spin them; and that they are spun is demonstrable by examination of some of the less hard and complete lids. You can see the threads stretching across and interlacing each other in every direction. Moreover, plenty of observers have seen them doing it, and watched their heads going to and fro with the regular spinning motion, under a commenced lid; so that there can be no doubt up to that point. But we must go a step further. Can they do it with their tails? Two of the wasp-pupæ in the doubly employed cells were outermost, and in both cases tail to the mouth of the cell, and a black cap or deposit of its droppings lay just within the lid. Miss Eleanor Ormerod observed the same thing; but in her case, although there may have been two pupæ in the cell (and in my own mind, I have no doubt there were), she did not observe it, but was struck only by the reversed wasp-pupa. At that time we had not met with any cells containing two pupæ, and she may have overlooked a *Rhipiphorus*-pupa below it; but she marked the cell, and I searched it subsequently without finding any traces of double employ; but it was some days after before I looked, and by that time the pupa might have decayed or shrunk, so as under my manipulation to have become confounded with the débris at the bottom of the cell. The cells containing these reversed wasp-pupæ were in every respect the same as the surrounding cells. The spun lid was the same, and also the silvery lining and the strong base—no back door or any means of feeding or getting in from behind. Now I hold it to be impossible for the full-grown larva to turn in its cell—that is, to reverse its position. It can turn and turn on its side, turn about and wheel about on its pivot; but turn summersaults it cannot. If the larva then spins the lid, it must apparently be able to supply the silk or matter of the thread,

and to spin it equally well with its tail as its head. I do not say that it does not; but it seems a very unusual aggregation of gifts, an *accumulatio munerum* for which there is no precedent. Nature never provides for unnatural or exceptional events, but leaves the unhappy victim of them to meet its fate and die.

The explanation which has occurred to me is this—a little far-fetched, perhaps; but the difficulty seems to warrant a stretch. There are two difficulties, the supply of the material and the spinning. As to the first, it must be remembered that the position of the cell is mouth downwards; so that if the fluid silk or glue was ejected in quantity from the mouth of the larva, it would naturally flow down its body or along the walls to the mouth of the cell. I suppose that the grub at that stage of its existence is constantly expectorating some of this glue (if we touch its head at that period, it may be seen to eject from its mouth a bell of clear liquid like water, which I have no doubt is liquid silk), and that the slimy-looking stuff on the walls of the cell is part of it which has adhered to them. When the grub is ready to pass into the pupa-state, it spins it into the lid; and its weight, elasticity, and adhesive qualities make it take the cup-shaped form the lid bears. If we examine one half finished, we see the threads crossing the outside rough and somewhat woolly; but I suppose a quantity of glue poured out on it from within, after it has reached this stage, penetrates the interstices and gives the outside the glossy look which the finished lid bears. Suppose, then, the larva reversed, no change will take place so far as regards the glue on the walls; it flows down them and coats them as before; but when the larva begins to spin, the head being now uppermost (the mouth of the cell being downmost), the glue will fall back and flow past the grub to the mouth of the cell. This would explain why there is no lid in the middle between the two pupæ; the movement of the other larva would be sufficient to prevent its settling, and the matter would then by gravitation find its way downwards. If the larva then is restless and moves its tail (which, although used as a sucker, it can detach and move as it likes) from side to side, it would imitate the motion of spinning and prepare a sieve of sufficient fineness to retain any more liquid that flows down, and so complete the lid. The only difference from the usual process would then be, that, instead of the material being supplied from the pendent mouth, it streams backwards down its body. That the larva has enough of this glue streaming from its mouth to cover the whole body will be apparent to

any one who looks at an unexcluded pupa nearly mature, when he will see it is clothed in a hardened cake of it all over.

This may explain the spinning of the lids to the cells of reversed wasp-pupæ; but what shall we say to those of the *Rhipiphori*? Have they the same *fluida sericina*? I suppose they must; but we want observation on this point; and for the present I must content myself with having pointed out the want.

These reversed larvæ present other difficulties. How do they maintain their place in this unnatural position? Normally their position is head downmost (not in reference to the cell, but to the ground). The cell has its mouth downwards, and the head of the grub is at the mouth of the cell. In that position one would expect it to fall out; but it uses its tail as a sucker, and hangs on by it. When you pull them out of the cell, you have to give a tug to bring them away. Reverse it, and it might hang on like a sailor by the teeth for a little, but certainly could not do so for any length of time. It must in any event sometimes open its jaws to eat, and it would then fall out. I suppose it must hold on as usual by the tail; only, instead of fastening itself at the base of the cell, it will do so on the sides of the mouth of the cell. It would have the disadvantage of the weight of the body pressing on the tail, instead of hanging from it; but I can see no other way in which it could be done. In the pupa-state both the reversed specimens had the tail adhering as a sucker to the black saucer of débris lying in the lid of the cell.

The manner in which these reversed larvæ can have been fed is another puzzle. Miss Eleanor Ormerod suggests that it may have been through an opening towards the base in an adjoining cell; but I can find no such opening, and, moreover, all the surrounding cells were themselves tenanted. It somehow seems not quite so difficult to imagine how it could be done with two larvæ in the cell (the one at the mouth reversed and the other not) as it would be with only one, reversed. The grub in the latter would have its mouth so far in the cell that the wasp coming with food might not be able to reach it; but when there are two (arranged as supposed), the inner one, of course, both has its own head halfway to the opening, and directed towards it, and also prevents the other going so far into the cell, and its head must just meet that of the inner one. Thus, if the wasp gets at the mouth of the inner one to feed it, the upper reversed one must always have the opportunity of taking a share of what is given to it.

I feel rather inclined to suppose that the only case in which

we can find reversed pupæ is when there are two in the cell. It is only under such circumstances that one can conceive the grub taking the reversed position. In the ordinary case of only one grub in the cell, it is so small when it first comes out of the egg, that it can turn and shift its position as it likes; and of course the position it likes will be that with its mouth to the food-bringer. But when there are two, if the egg first evolved be lowest, or, what is the same thing, if the grub first out has taken its position at the base of the cell with its head to the mouth of the cell, when the last evolved breaks out of the egg, the latter will naturally turn its head down to that of the former when it receives its food, in order to partake of it, and will gradually settle into that position until it grows too big to have room to change it. I am also inclined to believe that the only case in which two pupæ are found in one cell is when one of them is a *Rhipiphorus*.

I have only, in conclusion, to say that evidence of the accuracy of all the facts above recorded is, I think, to be seen in the collection in the South-Kensington Museum. As already said, I have not sufficient acquaintance with the economy of wasps and bees to be sure that the occurrence of reversed pupæ and grubs, although new to me, is not perfectly well known to hymenopterists, and that all the points I have been boggling at have not been clearly and satisfactorily explained; but I know that if they have not been previously observed, they will have and ought to undergo the usual scrutiny of doubt and suspicion. To any one who shall feel so far interested in the subject as to wish to test them, I would recommend the little black saucer of droppings taken from the mouths of the cells of the reversed pupæ as a good "*pièce justificatif.*" Its shape will tell that it did not come from the base of the cell, but must have come from the mouth. One of these is left actually *in situ* under the lid of the cell or cocoon; another is in a phial of Canada balsam (as to which, however, I may add the scarcely necessary caution that its position in relation to the pupa in the phial is not the natural one: when I put it in, its tail was still attached to it; but it became detached; and, in settling, it has wheeled round and its mouth come into contact with the black saucer; but no one knowing the nature of the saucer will mistake that for its natural position). The pupæ from these doubly tenanted cells are also there; and if there is anything I have overlooked, it is, I hope, unnecessary to say that I shall be happy to supply it to those who may wish to know more, if they will specify the points on which they desire information.

XLIII.—*Species of Terrestrial Mollusca collected on the Island of San Lucia.* By Ralph Tate, Assoc. Linn. Soc., F.G.S., &c.

Mr. Bland, in his Catalogue of the Pulmoniferous Snails of the West Indies (Ann. Lyc. Nat. Hist. New York, vol. vii.), gives but two species (*Helix orbiculata* and *Bulimus aulacostylus*) as inhabiting San Lucia. About two hours' search on the island, in the early part of this year, has enabled me to add ten species, making a total of twelve now known; they are as follows:—

1. *Helix orbiculata*, Fér. This snail has much the same habit as *H. aspersa* in this country, and is tolerably abundant about the town of Castries.
2. *Helix ierensis*, Guppy, Proc. Scient. Assoc. Trinidad, 1869, p. 242. This species belongs to a section of the genus represented by *H. lamellata* in Europe and *H. labyrinthica* in North America; the tropical forms are *H. cæca*, Guppy, *H. ierensis*, Guppy, Trinidad; *H. bactricola*, Guppy, Trinidad and Venezuela, Guyana; *H. cæcoides*, Tate, Nicaragua; and *H. caratalensis*, Tate, n. sp., Venezuela, Guyana. Inhabits, among rubbish of old walls and houses, Castries.
3. *Bulimus tenuissimus*, Fér. A few dead shells.
4. *Bulimus aulacostylus*, Pfr. One dead shell, but with coloration.
5. *Bulimus caracasensis*, Reeve. Several individuals were obtained.
6. *Stenogyra plicatella*, Guppy, var. Abundant with *Helix ierensis*.
7. *Stenogyra coronata*?, Guppy, with the last.
8. *Stenogyra octona*, Chemnitz. Abundant in the woods around Castries.
9. *Tornatellina lamellata*, P. & M. With the last.
10. *Cylindrella costata*, Guild. Upon damp walls and among stones in shady places; common.
11. *Succinea approximans*, Shuttl. Damp pastures.
12. *Helicina plicatula*, Pfr. Common in the woods about Castries.

Bulimus aulacostylus, Pfr., is the only species peculiar to the island; *Helix orbiculata*, *Cylindrella costata*, and *Helicina plicatula* are common to San Lucia and the islands to the north; whilst the remainder occur in Grenada, Trinidad, or the northern coasts of South America.

BIBLIOGRAPHICAL NOTICES.

Notes on the Geology of North Shropshire. Small 8vo, pp. 88. London: Hardwicke, 1869.

This little book, by Miss Charlotte Eyton, is well written and nicely printed, and must be a welcome companion to any intelligent inhabitant of Salop, or thoughtful tourist, if geologically inclined

and desirous of knowing the why and wherefore of the varied scenery and the many interesting points in the geographical structure of the district, and in its mineral and other products. Some sections, with outline views and a map, would, of course, greatly increase the value of this little book; and we trust that there are enough geological inquirers in Shropshire to use up this, and make way for an illustrated edition. In that reprint the technical names of "formations" should be more uniformly printed, either with or without capital letters. *Mytillus*, *Keüper*, and *Megalocervus* are nearly all the *errata* we observe. The careful manner in which the authoress has collected, used, and acknowledged the results of others' work is an example to many writers. Being an original observer, personally interested in her subject, and having clear views of what is before her, Miss Eyton gives a lucid and readable account of her district, from the old Cambrian rocks to the most recent alluvium, supplying trustworthy information to all, and a good basis of facts and notions for new observers to start from.

Figures of Characteristic British Fossils, with Descriptive Remarks. By W. H. Baily, F.L.S., F.G.S., &c. 8vo, Part II. London: Van Voorst, 1869.

This welcome continuation of Mr. Baily's useful work contains:—1st, pages xxv–xxxvi of Descriptive Remarks, including some clear and concise descriptions of the elementary constitution of Corals, Crinoids, and Polyzoans (with diagrams), as well as notes on the fossils of the Caradoc and Llandovery strata; 2nd, pages 31–61 of the Explanation of Plates (XI.–XX.), conveying very much information in a condensed form. The figures of the Fossils are necessarily well chosen by so experienced a palæontologist as the author, whether they be original or copied from published types. The printing of plates and text is better than at first. A few *errata* occur (*septæ* for *septa*, *Upper Caradoc* for *Llandovery*, *Ostracoda* for *Phyllopoda*, &c.), warning us that, with the greatest care a professional man can give to his "proofs," errors will creep in with the innumerable facts he has to notice and compile. Certainly geologists both at home and abroad must be glad to get Mr. Baily's work in their hands; and such slips of the pen are willingly lost sight of in so large a mass of carefully arranged and well illustrated information as is here offered to the student and general geologist.

MISCELLANEOUS.

On the Occurrence of Beania mirabilis *at Shanklin, Isle of Wight.* By Henry Lee, F.L.S. &c.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—I notice with pleasure the mention made by Mr. F. C. S. Roper of his having found *Beania mirabilis* at Eastbourne,

and beg to record its occurrence in another locality on our southern coast—namely, Dunnose, near Shanklin, Isle of Wight. Whilst residing there, three years ago, I one day brought in from a pool on the jutting spit of rock locally known as "the Ledge," a quantity of *Ætea anguina* (the snake's-head polyp), which grows abundantly there on *Rytiphlœa pinastroides.* I placed some of it in a "zoophyte-trough," and, whilst examining it under the microscope, I saw, to my surprise and delight, a few cells of *Beania mirabilis* entangled with it. The little daughter of a brother microscopist who was with me accidentally upset the trough, and my newly found treasure was lost. I left Shanklin on the following day, and have had no opportunity since then of searching for *Beania mirabilis* in the rock-pools of Dunnose.

I remain, Gentlemen, yours, &c.
HENRY LEE.

Cuttlefish (Sepia) *of the Red Sea.* By Dr. J. E. GRAY, F.R.S.

Savigny, in his plates on the 'Mollusca of Egypt,' figures a cuttlefish (*Sepia*), t. 5. f. 1–3, from the Red Sea. Audouin, in his explanation of those plates, considered it *Sepia officinalis.* This plate was copied in Férussac's 'Seiches' (t. 4) as *Sepia Savigniana*; Blainville and D'Orbigny altered this name to *S. Savignii*; and Ehrenberg, in his 'Symbolæ Physicæ,' gives to the figure the name of *Sepia Pharaonis.*

The bone of this species has not been described or figured.

Professor Ehrenberg obtained from the Red Sea, near Haman, a bone of a cuttlefish which is about 3 inches long and 1 inch wide, round at each end, and without any posterior spine, which he calls *Sepia gibbosa* (Symbolæ Physicæ, 1831); D'Orbigny altered the name to *Sepia gibba.*

M. Lefèbvre obtained at Cosseir some Cuttlefish-bones, which are described and figured by M. d'Orbigny under the name of *Sepia Lefebvrei*, Paléont. Univ. t. 4. f. 5, 6, 1845 (Férussac and D'Orb. Céphalop. t. 24. f. 1–6).

Mr. MacAndrew observed bones of Cuttlefish similar to the one here figured on the shores of the Gulf of Suez, and brought two specimens which are now in the British Museum. I think there can be little doubt that *S. Lefebvrei* is the same as *S. gibbosa*; and they both, as suggested by M. d'Orbigny, are the bones of *Sepia Savignii*, the bones of which have not otherwise been seen or described.

But the latter suggestion may be doubtful, as Mr. Feilder said that he had examined with his finger all the cuttlefish he saw in the market at Suez (where they are eaten, as they are in most of the towns on the shores of the Mediterranean), and that they all appeared to have a shell without the protuberance so peculiar in *S. Lefebvrei*; indeed Mr. MacAndrew brought home a specimen of a cuttlefish-bone without the protuberance on the inner side, and very like the bone of *Sepia officinalis*, and still more like *Sepia Rappeana*, from the Indian Ocean.

M. Lefèbvre also found at Cosseir some very slender bones of a cuttlefish which have the inner surface elevated into a central ridge as in *S. Lefebvrei*, and which D'Orbigny has described and figured under the name of *Sepia elongata*, Paléont. Univers. t. 4. f. 7–10 (Férussac and D'Orb. Céphal. t. 24. f. 7–10).

There is a third species in the British Museum with the central prominence, found on the coast of Australia, which I have described as *Sepia apama*, Gray, Cat. Cephal. Antepedia, p. 104, var. 10.

The Larva of Tischeria complanella *and its Parasite.* By Prof. Camillo Rondani.

Rondani has found the larva of *Tischeria complanella* living in oak-leaves, upon which its mines form spots similar to those produced by the larvæ of some other Tineidæ and those of *Orchestia quercus*. The leaves were brought to him by a friend, who wished to know by what insect the spots were produced. They were placed under a bell-glass, and in a few days two specimens of *Tischeria complanella* were observed endeavouring to make their escape. Other specimens continued to make their appearance until the end of July, the first having been observed about the middle of that month.

On examining the mines, most of the insects were found in the pupa-state; but some larvæ were discovered which had died without any apparent cause; and these, when placed in a vessel of water, acquired nearly the appearance which they must have possessed when alive. From the specimens thus swelled the author prepared the following description of the larva:—

The larva is footless or with indistinct feet, the sides being rugulose or tubercular to replace those organs. Head coriaceous, ferruginous, the following segments very pale yellowish and somewhat translucent, except the last, which are confused into one large ferruginous piece; first or cephalic segment broader, marked above with a large, subquadrate, blackish spot; the remainder with a yellowish or brownish-yellow dorsal longitudinal vitta; all furnished at the sides with a few minute hairs. It lives between the epidermides on the parenchyma of the leaves of *Quercus pedunculata* and perhaps other species.

Simultaneously with the moths, a considerable number of minute Hymenopterous parasites were produced from the leaves; they feed upon the larvæ of the *Tischeria*, and destroy many of them. This parasite belongs to the Chalcididæ, and to the subfamily *Encyrtinæ*; but the author was unable to refer it to any of the genera of that group with the characters of which he was acquainted. As Mr. Haliday concurred with him in regarding it as a new generic type, he has characterised it as follows, under the name of

Tineophaga, nov. gen.

Antennæ 7-articulatæ, seu scapo et articulis 6 flagelli instructæ in utroque sexu; primo articulo flagelli brevi, cæteris in fœmina

subovatis, in mare oblongioribus, quorum 3, in hoc sexu, filamento longo fimbriato præditis.

Alæ superæ extensæ, vena costali exilissima, appendicula apicali oblique in dilatationem terminante, et alia venula spuria prope marginem posteriorem, longitudinaliter decurrente ultra medium præditæ.

Abdomen apice subacuminato et sursum paulo incurvatum, basi angustatum.

Pedes simplices, tibiis intermediis unicalcaratis, tarsis omnibus 5-articulatis.

Tineophaga Tischeriæ, sp. nov.

Nigra, nitida, glabra; maris et fœminæ antennæ nigræ, articulo primo flagelli sat breviore sequentibus; maris articulo secundo, tertio et quarto appendice longa præditis filiformi, breviter fimbriata, articuli secundi longiore, quarti minore. Abdomen maris ad basim in medio paulo albido-translucidum. Alæ limpidissimæ, nudæ. Pedes femoribus late nigris; tibiis cum coxis anterioribus totis albis, posticis apice nigricante; tarsis omnibus albis, apice fusco.

The size of the parasite is not given. The larva of *Tischeria*, the legs and antennæ of the perfect insect, and the details of the structure of its parasite are figured.—*Annuario della Soc. dei Natural. in Modena*, anno iii. pp. 20–24, pl. 4.

A Naked Shrew. By Dr. J. E. Gray.

Mr. P. Garner, of Stoke-upon-Trent, has kindly sent to the British Museum a Naked Shrew. It was caught on the border of a wood in Staffordshire on a hot day, but died from being enclosed in a botanical box.

The whole of the upper surface of the body and head is destitute of hair, and the skin is corrugated like that of the Naked Mice (*Mus*) figured by Mr. Gaskoin in the 'Proceedings of the Zoological Society,' 1856, Mamm. pl. 41.

On Spoggodes conglomeratus, *and a new Genus of Fleshy Alcyonoids.* By Dr. J. E. Gray, F.R.S. &c., and Henry J. Carter, F.R.S.

Mr. Robert Swinhoe has brought from North China a dried specimen of a fleshy Alcyonoid for the British Museum, that appears to belong to a genus hitherto unnoticed; and Mr. Carter has kindly examined and drawn its structure and spicules for me. It may be called

Eusclerides.

The coral fleshy, consisting of a growth of thick contorted laminæ with rounded upper edge, the lower part of the lamina and base bare, the upper part with regularly disposed polypes with numerous small concavities placed at the base on the surface between the.

polype-cells; the inner part strengthened with thick, fusiform, longish tubercular spicules with three or five wide, smooth, sunken cross bands, separating the tubercular surface of the middle of the spicules into bands respectively. The spicules in shape are like those figured by Prof. Kolliker, in his 'Icones Histiologicæ,' t. 18. f. 31 & 39, as found in *Gorgonia setosa* and *G. sanguinolenta*; f. 42 & 43, *Gorgonella pseudo-antipathes* and *G. granulata*.

Euscler ides chinensis.

Hab. North China. B.M.

Mr. Carter says, "The spicule is calcareous, tubercular, elliptical, presenting from three to five smooth bands, or intervals without tubercles, alternating with the tubercular ones, all forming so many circular rings round the central axis of the ellipse. About twice as long as broad, and $\frac{1}{125}$ inch long.

"There are seldom more than three smooth bands, and these may be more or less irregularly disposed; but the figure given shows the average form and size of the spicules, though taken from one of those which are most symmetrically formed. The whole tissue is pregnant or densely charged with them.

"The magnified surface shows the form of the pits; the larger are situated in the middle of the smaller, cup-shaped ones. The larger ones contain the animal with its eight divisions, showing the dry contracted animal. In the centre of each of the smaller cups is an aperture which may be an outlet for the ova, which abound in the structure round the large cells. Urticating organs are also present."

Mr. Carter has also sent me a drawing, with some interesting details of the structure, of a species of *Spoggodes* which was brought up from the bottom of the sea off the south-east coast of Arabia, on a fishing-hook. The coral was of a "greyish colour, more or less transparent, firmly gelatinous interiorly, semicrusted with rough, fusiform calcareous spicules externally. Animal pinkish, just visible, surrounded by a cupwork of fusiform spines, one of which is much longer than the rest. Skeleton of spine- or spicule-work consisting of different-sized fusiform spicules. The branches are branched, the branchlets short, each ending in a spherical head of polypes more or less bristled by the projecting calcareous fusiform spicules."

The mass is large and short (5 inches each way), with very thick, rather compressed, barren stems, divided above into short, thick, rounded lobes, which are covered with clusters of short branches ending in spherical heads of polypes. I propose to call the species, which is evidently very distinct from any I have before seen, *Spoggodes conglomeratus*.

On the Anatomy of the Genus Gordius. By H. Grenacher.

The singular results obtained by M. Meissner, in his anatomical researches on the Gordiacea, have induced the energetic expression of doubts on the part of several naturalists; the conscientious work of M. Grenacher ought therefore to be welcome to all. The author has

taken as the subject of his dissections some large tropical species, and he has verified the exactness of the results obtained in the *Gordius subbifurcus* of Europe.

We may distinguish, with M. Schneider, in the skin of all the true Nematodes, two layers—the one internal and cellular, lying directly on the muscles, called the subcutaneous layer, and the other external, the cuticle, secreted by the first. The two layers occur in exactly the same way among the Gordiacea; but M. Meissner entirely misunderstood their nature. He considered the subcutaneous layer as being in direct relation with the muscular system, and gave it the name of perimysium. As to the cuticle, it is formed of two laminæ, of which the innermost was regarded by M. Meissner as a fibrillar corium, and the external as an epidermis of cellular nature.

In immediate dependence upon the skin is the organ which M. Meissner has described as a *ventral nervous cord.* M. Schneider was afterwards better inspired in regarding this cord as the homologue of the ventral line of the Nematodes. Nevertheless, in his monograph of the Nematodes, he abandons this opinion and regards the cord in question as an œsophagus deprived of all communication with the intestine—that is to say, as the morphological equivalent of an œsophagus, not fulfilling the functions generally supposed to belong to that part. It does not, indeed, present any mouth in front, or any communication with the intestine behind. This interpretation is energetically opposed by M. Grenacher. This observer recurs to the first idea of M. Schneider, and regards the supposed nervous cord as homologous with the ventral line of the Nematodes. He shows besides, by means of a series of very convincing sections, that this organ is really an excrescence of the subcutaneous layer. A narrow fissure of the muscular cylinder along the ventral line permits a lamina to pass, which establishes the continuity of the tissue between the subcutaneous layer and the ventral cord.

The muscular system of the body of *Gordius* forms in the interior of the subcutaneous layer a cylindrical layer, interrupted only along the ventral surface by the gap through which the ventral cord communicates with the subcutaneous layer. This cylinder is composed of laminæ, which M. Schneider compares with the fibrillæ of the other Nematoda. M. Grenacher, on the contrary, regards each lamina as a muscular cell, homologous with those of the Polymyaria. These laminæ, indeed, are not solid, but each constitutes a tube, though, it is true, of very small calibre. The calibre is directly comparable to the medullary mass of the muscles in the other Nematoda. The author has not, however, succeeded in finding the nucleus of these muscular cells.

The tube formed by the different layers of the body-wall that we have just described is filled with a cellular tissue, in which the other organs are immersed. This tissue is designated by M. Grenacher the *perienteric connective substance.* It is to it that M. Meissner, by a curious interpretation, ascribed the function of an intestinal canal. He assumed, in fact, that the mouth led directly into the cavity filled by this tissue; so that the genital organs would have been lodged in

a solid intestinal canal filling all the body. M. Schneider has already rejected this curious interpretation; but he regards the perienteric tissue as a dependence of the muscular tissue, of which it would represent the medullary substance extraordinarily developed.

It is generally admitted that the Gordiacea are without internal organs of reproduction so long as they lead the life of parasites. This may be true of *Mermis*; but as regards *Gordius* M. Grenacher shows that the generative organs are already completely developed during the phase of parasitism. It is not true that in these animals the intestine terminates cæcally, and that there does not exist any opening playing the part of an anus. In the females the intestine opens into the uterus immediately in front of the sexual pore, so that this last is in reality the opening of a cloaca. The uterus, however, soon divides into three canals, of which the two lateral are the oviducts, and the middle one is the direct continuation of the uterus, but performs the part of a seminal receptacle. In the males there also exists a cloaca in the form of a sac, presenting three orifices—one, superior and median, leading into the intestine, the other two, smaller and lateral, corresponding to the deferent canals.

The variable statements of authors with regard to the digestive system of the Gordiacea are explained by the following facts, ascertained by the author. So long as they are in the state of parasites, the *Gordii* present a distinct mouth leading directly into an intestinal canal lined with epithelium; but at the time of migration, or immediately before it, the mouth appears to be obliterated in the greater number of species. It disappears then entirely, or there only remains a slight, scarcely perceptible, trace of it. The anterior part of the intestinal canal seems also to become atrophied, and the place that it occupied before is henceforth filled with the perienteric tissue. These remarkable modifications had already been foreseen by M. Blanchard. In 1849, he expressed himself as follows:—"We remark in the *Gordii*, at least in the adults, the atrophy of the intestinal canal. This suffices, up to a certain point, to separate the Gordiacea from the Nematoïdes; and yet we are not in a position to describe clearly the digestive tube of a single *Gordius*, for it would be necessary to have observed it at different ages of the life of the animal." Most zoologists of late years have approximated the *Gordii* to the Nematodes. Diesing has formed, under the name of *Nematoda aprocta*, a group including *Mermis*, *Gordius*, and the *Sphærulariæ*. The name proposed by the Viennese naturalist, at all events, cannot be maintained: in the first place, the absence of an anus (true, perhaps, as regards *Mermis* and the *Sphærulariæ*) will not hold good in *Gordius*; in the second place, we know now of true Nematodes appearing to be without any anal opening whatever (*Ichthyonema*). The results obtained by M. Grenacher seem to remove the genus *Gordius*, more than is generally supposed, both from the true Nematodes and from *Mermis*. M. Schneider has already pointed out a certain number of differential characters. To these we must now add the existence of a cloaca in both sexes of *Gordius*, in the male sex only of the Nematodes; then the existence in *Gordius* of that con-

nective perienteric tissue, in the parenchyma of which the internal organs are lodged and fixed. Hence M. Grenacher concludes that it is necessary to separate *Gordius*, more than is usually done, both from *Mermis* and from the true Nematodes, at the same time approximating *Mermis* to the latter.—*Zeitschr. fur wiss. Zoologie*, xviii. p. 322; *Bibl. Univ.* August 15, 1869, *Bull. Sci.* pp. 308–311.

On the Development of Pelobates fuscus, *Wagl.*
By C. van Bambeke.

The author treats of a subject which has not hitherto been investigated—the embryogeny of *Pelobates fuscus*. His history of its development commences with the ovarian egg, and closes at the period when the internal branchiæ replace the external branchiæ—that is to say, when the principal organs are sketched out. He first of all describes the process which he has followed in making his preparations. The object is to obtain sections sufficiently delicate for microscopic examination by transmitted light, this method being the only one which leads to positive results in the anatomical investigation of the various phases of embryonic development. For further details the reader must refer to the memoir.

The ovum is described, with the appearance which it presents in the ovary. The deposition of the secondary vitellus in the protoplasm of the primordial ovum takes place uniformly round the germinal vesicle, and not in the form of a nucleus; the germinal vesicle is enclosed in a cavity closely approximated to the periphery of the ovum, and has no external communication by a canal; the rupture of the germinal vesicle always precedes the quitting of the ovary by the ovum; and there is no true vitelline membrane (*Eizellmembran* of Remak). These are the chief peculiarities presented by the ovum before its extrusion.

In the upper hemisphere of the fecundated ovum a clear solid nucleus makes its appearance; this becomes the starting-point of the segmentation, which sometimes commences upon the very border of the germinal pit (*fovea germinativa* of Schultze). The circlet of folds (*Faltenkranz* of the Germans) is very distinct in the ovum of *Pelobates* during the first phases of segmentation. The division into two spheres takes place in such a manner that the part still undivided, instead of being central, occupies the periphery of the ovum, and corresponds to the inferior pole.

The formation of the primitive visceral cavity results from the multiplication of the cells of the deeper layer of the dome which covers the cavity of segmentation. In consequence of this cellular prolification, the above-mentioned layer is incurved and covers the clear hemisphere. As soon as the primitive visceral cavity has replaced the cavity of segmentation, the embryonal lamellæ are distinct. Of these there are four, namely:—

1. An external lamella (enveloping membrane).

2. A second lamella, which the author, like Prof. Stricker, regards as the true sensorial lamella.

3. A third lamella, which corresponds to the motory germinal lamella of the higher Vertebrata.

4. A fourth lamella, the analogue of the glandular or trophic lamella (*Trophisblatt* of Remak).

In *Pelobates* the primitive streak does not precede the dorsal furrow, but appears at the same time as the latter: these two parts are at first visible only in the posterior half of the dorsal region of the future embryo; but the dorsal furrow is soon completed, when its form is characteristic, and most frequently the primitive streak cannot be distinguished in its anterior half. The clear surface has an ovoid form; its anterior limit corresponds to a dark zone which shows itself at the same time as the dorsal furrow and primitive streak; this is the *cephalic crescent*, of which the subsequent modifications are very remarkable in *Pelobates*.

The microscopical examination of transparent sections shows clearly that, in *Pelobates*, the production of the dorsal furrow is effected solely at the cost of the outer lamella (enveloping membrane). This latter behaves like the sensorial lamella of the higher Vertebrata at the period of the formation of the nervous canal; only, when the dorsal furrow is closed, the tube produced by this closure is not yet the nervous canal, which is afterwards completed by the incurvation of the thick part of the sensorial lamella.

At its anterior part the thickened portion of the sensorial lamella not only gives origin to the cerebral cells and ocular vesicles, but, after the occlusion of the nervous canal, there remains, on each side, an aggregation of cells which become the origin of the auditory vesicle and of the nervous part of the olfactory organ. The latter becomes the olfactory lobule, which therefore is not, in *Pelobates*, an excrescence of the anterior cerebral cell, and only comes into contact with this gradually.

As regards the motory germinal lamella, we shall only say here that the cutaneo-dorsal laminæ are not derived from the peripheral portion of this lamella, but are produced in their place by the laminæ of the primitive vertebræ. The dorsal cord, the Wolffian bodies, and the external and internal branchiæ originate from the motory lamella.

Lastly, the author believes we may regard as the first rudiments of the kidneys two small masses of cells formed at the expense of the glandular lamella; but he has been unable to ascertain what relation there exists between these organs and the excretory ducts of the Wolffian corpuscles.—*Mém. de l'Acad. Roy. de Belgique.* Abstract communicated by the Author.

On the Systems of Capillary Vessels in the Gasteropods. By Prof. Wedl.

The doctrines that are now generally accepted in France and elsewhere with regard to the blood-vascular system of the Mollusca

were originated by M. Milne-Edwards. These doctrines may be summed up in the thesis that this vascular system is lacunary, and in communication both with the cavity of the body and with the exterior world. M. de Quatrefages also taught, as early as 1844, the existence of an extravascular circulation, among the Gasteropods of the family Eolididæ, which he classed among his "*Gasteropodes phlébentérés.*" Souleyet energetically opposed this notion, and asserted the existence in these animals of a venous system, similar to that of the higher animals. M. Robin (1851), after carefully criticising the works of Cuvier and of MM. Milne-Edwards, Quatrefages, Blanchard, and Owen, pronounced in favour of Souleyet and the closed vascular system, and consequently against phlebenterism.

Notwithstanding the objections of Souleyet and M. Robin, notwithstanding the anatomical researches of MM. Keber and Langer, notwithstanding the fine injections of the latter, which have demonstrated the existence of a system of capillary vessels and at the same time the absence of an aquiferous system in these Lamellibranchs, notwithstanding all this, M. Milne-Edwards maintains to this day the existence of a lacunar circulating system in all the Mollusca, with vessels widely gaping in the cavity of the body and externally. M. Wedl has just carefully resumed this study, and, like Souleyet and M. Robin, M. Keber and M. Langer, he declares most positively against M. Milne-Edwards.

The method employed by M. Milne-Edwards was insufficient. He contented himself with injecting a solution of chromate of lead into the perivisceral cavity by a small opening made in the back or elsewhere. M. Agassiz, by making injections through the mouth or the anus, thought he could also demonstrate a direct communication between the digestive organs and the circulatory system. M. Robin has already characterized these processes as coarse. Thus, for instance, it is certain that in opening the perivisceral cavity it is easy to open at the same time a blood-sinus or some large vessel, and to make the injection penetrate through this.

M. Milne-Edwards cites in support of there being a communication of the vessels with the perivisceral cavity the following evidence, which one cannot help thinking singular. When he examined with the microscope the blood of the ventricle of the heart and the perivisceral liquid in a living *Helix*, he found the two liquids perfectly similar, both of them containing blood-corpuscles. Now it is not possible to open the perivisceral cavity without cutting a quantity of vessels, whose contents fall into the cavity. M. Wedl, on the contrary, by making his injections through the heart, has ascertained that in *Helix* the injected mass does not penetrate into the perivisceral cavity, and does not go out at the exterior surface.

It is remarkable that M. Milne-Edwards in his works never speaks of the capillary vessels, which might lead one to suppose that he has never seen them. Several naturalists whom this author ranks among his adherents nevertheless differ from him on certain points. Mr. Owen and M. Blanchard in particular never speak of true lacunæ,

but of sinuses with proper walls. However, all the German zoologists appear to have passed into the camp of M. Milne-Edwards. M. Eberth alone, in consequence of some injections with nitrate of silver, thinks he has ascertained that the blood-canals of the Gasteropoda have proper walls, and cannot be regarded as lacunæ.

The best method of studying the circulatory passages of the Gasteropoda is to make an injection by the ventricle, or, still better, by the auricle or by a large vessel. There are, however, some cases in which this method cannot be employed—as, for example, among the *Murices* and the *Turbines*, in which the heart, which is extremely small, is protected by the thickest part of the shell. In these cases M. Wedl has also employed the method of pricking in the neighbourhood of the sinuses or of some large vessel.

The result of the numerous researches of M. Wedl is to prove the existence in the Mollusca of a completely closed vascular system, with capillary networks in the greater part of the organs. The type of distribution of these is extremely variable, and intimately connected with the structure. It is thus that in the *Murices* the skin of the trunk and of the back is formed of several superposed layers of muscular fibres, crossed in different directions, and that several networks of blood-vessels are likewise superposed in these parts. The vascular networks are superposed in the same manner in the foot of these Ctenobranchs. In the warty skin of *Helix* we find a distinct capillary system for each verrucosity. In all cases where the skin is very erectile, as in the foot of the *Limaces*, the capillary vessels are very large, and embrace very small meshes. The very erectile part of the mantle presents an extraordinary vascularity with very narrow meshes, whilst that part of the mantle which envelopes the kidneys and the liver does not present by any means a like richness. In no part of the skin is there any communication between the veins and the exterior. Nor do the veins appear to communicate with the aquiferous vessels. M. Wedl, however, has not been able to determine whether these last open directly into the perivisceral cavity, or whether they are distributed only in the foot.

The digestive organs of the Gasteropoda present great variations in their intimate structure. Among the *Helices* and *Limaces*, the circulatory system both of the mucous and of the external surface of the intestine is perfectly closed. There even exists a rich capillary network in the duplicature of the mucous membrane which encloses the radula. In the liver, which has no portal system, the bile is secreted by the arterial blood. Some arteries encompass the acini; the mode of ramification of the vessels is that of a clustered gland.

The capillary network of the inner surface of the lungs in the ate Mollusca is one of the richest in the organism, just like of the branchiæ in the Ctenobranchs. We find networks composed of large meshes in the kidneys, around the mucus-glands and flagellum, and in the seminal capsule (in *Helix*), whilst the albumi-

nous and hermaphrodite glands have networks of oval and round meshes. The eye and the ganglia of *Helix* present numerous vascular rings united by anastomoses.

Although the researches of M. Wedl have been confined to a small number of species, they suffice, however, to show that the doctrines taught by M. Milne-Edwards with regard to the circulation of the Mollusca will not hold good of all animals of this class*.—*Sitzungsber. Akad. Wiss. Wien*, 1868, ii.; *Bibl. Univ.* September 15, 1869, *Bull. Sci.* pp. 76-80.

Discovery of New and Rare Fossils in the Marl-Slate of Midderidge.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Will you allow me a line in the next Number of the 'Annals' to record the discovery, by Joseph Duff, Esq., of the following interesting species in the Marl-Slate of Midderidge? viz.:—two specimens of *Proterosaurus Speneri*; a specimen of a large reptile of undetermined genus and species; several examples of *Dorypterus Hoffmanni*, Germar; four groups of the palatal teeth of *Janassa bituminosa*, Schloth., sp.; a specimen of *Acrolepis exsculptus*, Munst.; and the head and teeth, up to the present time unknown, of *Acrolepis Sedgwickii*, Ag., and *Cœlacanthus granulatus*, Ag.

With these remarkable novelties were associated numerous remains of the fishes and plants already figured and described in English works, and some additional forms of plants not hitherto announced from the Marl-Slate of England. All these will from time to time be described in detail in the pages of the 'Annals.'

I remain, Gentlemen,
Yours truly,
Richard Howse.

17 Saville Row, Newcastle-upon-Tyne.
October 25, 1869.

* Without disparaging the importance of the discovery made by M. Wedl of the numerous capillary networks in the Gasteropods, we do not think that the non-existence of vast blood-sinuses, or especially the absence of communication of the vascular system with the exterior world in these animals, necessarily follows therefrom. Quite recently we have ourselves examined the communication of the pericardiac sinus with the exterior by means of the excretory organ in *Phyllirhoë*, and we do not think that the existence of this communication can be for one instant doubted. This also applies to an analogous arrangement described in the Pteropoda by M. Gegenbaur and other authors, &c. &c.—E. Claparède.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 24. DECEMBER 1869.

XLIV.—*List of Coleoptera collected in Vancouver's Island by* Henry *and* Joseph Matthews, *with Descriptions of some new Species.* By Dr. J. L. LECONTE, Philadelphia.

By the kindness of my friend the Rev. A. Matthews, I have been permitted to examine a very interesting series of Coleoptera collected by his brothers Henry and Joseph Matthews in Vancouver's Island and British Columbia. Though pertaining to the same zoological district as Oregon and Washington Territories, several species not yet obtained from other localities occur in Messrs. Matthews's collection; and, what is of equal interest, several species known from the eastern and central parts of the continent have been found to extend their range to the Pacific slope.

Among the former, *Zacotus Matthewsii* (a magnificent copper-coloured Broscide, resembling in form *Promecoderus*, but allied by generic characters to *Miscodera*) stands preeminent as one of the most remarkable additions recently made to the North-American insect-fauna. Of those which have been found to extend their western range beyond the limits within which they were previously known may be mentioned:—*Nebria mœsta*, *Psydrus piceus*, *Platynus cupripennis*, *P. bembidioides*, *Anisodactylus nigrita*, *Dytiscus Harrisii*, *Leistotrophus cingulatus*, *Elater apicatus*, *Corymbites inflatus*, *Clerus nubilus*, *Tricrania Stansburii*, *Tragosoma Harrisii*, *Acmæops strigilata*, *Callidium janthinum*, *Monohammus scutellatus*, *Saperda calcarata*, *Pl*[illegible]*? fasciatus*.

The occurrence in a far northern locality of such forms as *Omus Audouinii* and *Dejeanii*, *Promecognathus lævissimus*, *Amara californica*, *Chlænius harpalinus*, *Dichirus piceus*, *Necrophorus nigrita*, *Necrophilus hydrophiloides*, *Odontæus obesus*, *Polycaon Stoutii*, *Cœlus ciliatus*, *Cœlocnemis dilati-*

collis, *Ergates spiculatus*, and *Mesosa Guexi*, all of which are found on the Pacific slope in more southern regions of Oregon and California, is an instructive fact, and not without significance as indicating a greater uniformity of the climate of the maritime parts of the continent than has been heretofore suspected.

In conclusion, I would desire to express my most sincere thanks not only for the privilege of investigating the series of Messrs. Matthews, but also for the great liberality with which I have been permitted to select from it such specimens as were desirable additions to my cabinet.

Omus Audouinii, *Reiche*.
—— Dejeanii, *Reiche*.
Cicindela purpurea, *Oliv.*
—— vulgaris, *Say* (green race).
Elaphrus californicus, *Mann.*
Blethisa oregonensis, *Lec.*
—— *acutangula*, Chaud.
Loricera 10-punctata, *Esch.*
Trachypachys inormis, *Motsch.*
Nebria Mannerheimii, *Esch.*
—— mœsta, *Lec.*
Leistus ferruginosus, *Mann.*
Calosoma tepidum, *Lec.*
Carabus tædatus, *Fab.*
Cychrus tuberculatus, *Harris.*
—— velutinus, *Men.*
—— angusticollis, *Fischer.*
—— angulatus, *Harris.*
—— marginatus, *Dej.*
Promecognathus lævissimus, *Chaud.*
Platynus ovipennis (*Mann.*).
—— metallescens, *Lec.*
—— carbo, *Lec.*
—— cupripennis (*Say*), var.
—— lutulentus, *Lec.*
—— strigicollis, *Lec.*
—— bembidioides (*Kirby*).
—— fraterculus, *Lec.*, n. sp.
Pterostichus herculaneus, *Mann.*
—— algidus, *Lec.*
—— amethystinus, *Mann.*
—— longicollis, *Lec.*
—— 6-punctatus (*Mann.*).
Holciophorus ater (*Dej.*).
Amara scitula, *Zimm.*
—— impuncticollis, *Say.*
—— californica, *Dej.*
Badister anthracinus, *Lec.*
Chlænius harpalinus, *Esch.*
Zacotus Matthewsii, *Lec.*, n. sp.
Psydrus piceus, *Lec.*
Anisodactylus (Dichirus) piceus (*Men.*).
—— nigrita, *Dej.*
—— semipunctatus, *Lec.*
—— confusus, *Lec.*
Harpalus cautus, *Dej.*
Patrobus fulcratus, *Lec.*, n. sp.
Bembidium simplex (?), *Lec.*
——, n. sp.
Anisomera recta, *Lec.*, n. sp.
Colymbetes densus, *Lec.*
Dytiscus parvulus, *Mann.*
—— Harrisii, *Kirby.*
Necrophorus maritimus, *Mann.*, var. confessor, *Lec.*
—— nigrita, *Mann.*
—— pollinctor, *Lec.* (nec *Mann.*).
Silpha lapponica, *Herbst.*
Necrophilus hydrophiloides, *Mann.*
Creophilus villosus (*Grav.*).
Leistotrophus cingulatus (*Grav.*).
Philonthus californicus, *Mann.*
——, sp.
Lathrobium, sp.
Temnochila viridicyanea, *Mann.*
Peltis Pippingsköldii, *Mann.*
Pediacus planus, *Lec.*
Cucujus puniceus, *Mann.*
Orphilus subnitidus, *Lec.*
Platycerus cærulescens, *Lec.*
Ceruchus striatus, *Lec.*
Sinodendron rugosum, *Mann.*
Odontæus obesus, *Lec.*
Dichelonycha fulgida, *Lec.*
Serica anthracina, *Lec.*
Diplotaxis brevicollis, *Lec.*
Polyphylla 10-lineata, *Lec.*
Chalcophora angulicollis, *Lec.*
Dicerca crassicollis, *Lec.*
Ancylochira rusticorum, *Lec.*
—— Langii, *Lec.*

Ancylochira lauta, *Lec.*
—— adjecta, *Lec.*
Melanophila Drummondi (*Kirby*).
Chrysobothris trinervia (*Kirby*).
Fornax basalis, *Lec.*
Epiphanis cornutus, *Esch.*
Anelastes Latreillei, *Lec.*
Adelocera rorulenta, *Lec.*
—— cavicollis, *Lec.*
Cardiophorus longulus, *Lec.*
Cryptohypnus funebris, *Cand.*
Elater apicatus, *Say.*
—— cordifer, *Lec.*
—— phœnicopterus, *Lec.*
—— anthracinus, *Lec.*, n. sp.
Megapenthes stigmosus, *Lec.*
Dolopius macer, *Lec.*
Limonius subauratus, *Lec.*
—— nitidicollis, *Lec.*, n. sp.
Athous ferruginosus, *Esch.*
—— scissus, *Lec.*
—— vittiger, *Lec.*
Sericosomus incongruus, *Lec.*
Corymbites æripennis, *Lec.*
—— carbo, *Lec.*
—— Suckleyi, *Lec.*
—— cruciatus, *Linn.* (race festivus, *Lec.*).
—— triundulatus (*Randall*).
—— nubilus, *Lec.*
—— bombycinus (*Germ.*).
—— inflatus (*Say*) = glaucus, *Germ.*
—— fraternus, *Lec.*, n. sp.
—— gracilior, *Lec.*
Asaphes morio, *Lec.*
—— oregonus, *Lec.*
Eros hamatus, *Mann.*
Photinus facula, *Lec.*
Podabrus comes, *Lec.*
Trichodes ornatus, *Say.*
Clerus sphegeus, *Fab.*
—— eximius, *Mann.*
—— nubilus, *Lec.*
Polycaon Stoutii, *Lec.*
Cioide, sp.
Phellopsis porcata, *Lec.*
Cœlus ciliatus, *Esch.*
Coniontis ovalis, *Lec.*
Eleodes producta, *Mann.*
Cœlocnemis dilaticollis, *Mann.*
Iphthimus serratus (*Mann.*).
Helops lætus, *Lec.*
Dendroides ephemeroides (*Mann.*).
Phryganophilus collaris, *Lec.*
Meloë montanus, *Lec.*
Tricrania Stansburii (*Hald.*).
Ditylus gracilis, *Lec.*
Asclera nigra, *Lec.*, n. sp.
Priognathus monilicornis (*Rand.*).
Dyslobus decoratus, *Lec.*, n. sp.
—— granicollis, *Lec.*, n. sp.
Phyllobius ?, sp.
Alophus didymus, *Lec.*
Hylobius ? tæniatus, *Lec.*
Plinthus carinatus, *Mann.*
Pissodes costatus, *Mann.*
Rhyncolus, sp.
Platyrhinus ? fasciatus (*Oliv.*).
Ergates (Trichocnemis) spiculatus, *Lec.*
Tragosoma Harrisii, *Lec.*
Asemum atrum, *Hald.*
—— ? asperum, *Lec.*
Criocephalus productus, *Lec.*
Tetropium velutinum, *Lec.*, n. sp.
Ulochætes leoninus, *Lec.*
Necydalis lævicollis, *Lec.*, n. sp.
Rhagium lineatum, *Oliv.*
—— investigator, *Mann.*
Toxotus flavolineatus, *Lec.*
—— spurcus, *Lec.*
—— vestitus, *Hald.*
Acmæops strigilata (*Fabr.*).
Leptura cribripennis, *Lec.*
—— sanguinea, *Lec.*
—— dehiscens, *Lec.*
—— valida, *Lec.*
—— chrysocoma, *Kirby.*
—— læta, *Lec.*
—— fasciventris, *Lec.*
—— quadrillum, *Lec.*
—— dolorosa, *Lec.*
—— obliterata (*Hald.*).
—— Matthewsii, *Lec.*, n. sp.
—— fuscicollis, *Lec.*
—— scripta, *Lec.*, n. sp.
Clytus undulatus, *Say.*
—— Sayi, *Lap.*
Rosalia funebris, *Motsch.*
Callidium janthinum, *Lec.* (race).
—— dimidiatum, *Kirby.*
—— vulneratum, *Lec.*
—— (Semanotus) ligneum, *Fabr.*
Atimia dorsalis, *Lec.*, n. sp.
Ploctrura spinicauda, *Mann.*
Mesosa Guexii, *Lec.*
Monohammus scutellatus (race), *Say.*
Saperda calcarata, *Say.*
Adimonia externa (*Say*).

New or remarkable Species.

CYCHRUS.

Cychrus angulatus, Harris, Bost. Journ. Nat. Hist.

The recovery of this remarkable species, the type of which has disappeared, enables me to add some characters to those briefly indicated by Dr. Harris. The thorax is much more polished and convex than in any other species found on the Pacific slope of America, and is very narrowly margined and deeply channelled; the sides are distinctly angulated in front of the middle, oblique towards the tip, strongly sinuate towards the base, the angles of which are rectangular and prominent; the transverse impressions are deep, the basal ones well marked, not punctured. The elytra are elongate-oval, narrower than in *ventricosus*, but sculptured in nearly the same manner, with sixteen deeply impressed, closely punctured striæ, of which the two outermost are confused.

The head is obtusely elevated in the middle, and narrowly carinate at each side above the insertion of the antennæ, the carinæ extending along the superior margin of the eyes, and bending around their hind margin; the first joint of the antennæ is stouter than in *C. ventricosus*, but neither as thick nor as long as in *C. cristatus*. The feet of the specimen (a female) are proportioned as in *C. ventricosus*.

Cychrus tuberculatus, Harris, Bost. Journ. Nat. Hist.

The specimen submitted to me by Mr. Matthews is much larger (23 millims. long) and stouter than those in my collection, and is therefore evidently a female: this species is therefore to be placed among those in which the anterior tarsi are not dilated in the male nor furnished beneath with brushes of hair. It differs from all the other species, not only by the peculiar sculpture (scabrous upon the head and thorax, tuberculated upon the elytra), but by the antennæ being shorter, scarcely more than half the length of the body, with the first and third joints equal in length, and the second but little shorter; the labrum is scarcely longer than wide, and less deeply bilobed than usual. The palpi of the male are more broadly securiform than those of the

PLATYNUS.

Platynus ovipennis (Mann.).

This species, rare in California, has not been heretofore found in the more northern regions. It is easily distinguished

by the regularly oval, deeply striate elytra, without distinct humeral angles, though the base is slightly emarginate, and the basal fold meets the margin in a well-defined angle; the dorsal punctures are three—the first on the third, the other two on the second stria; the wings are not developed. The prothorax is quadrate-ovate, narrowed behind, scarcely wider than long, with the sides strongly but not widely margined, and subsinuate behind; the hind angles rectangular, not rounded in five specimens, feebly rounded in a sixth; the base is truncate, finely margined, somewhat oblique at the sides near the angles; the transverse impressions are well marked, and the basal impressions are deep and not punctured. The under surface of the joints of the front tarsi of the ♂ are clothed with long golden-yellow hair; the front tarsi are without grooves; the middle and hind tarsi have a distinct exterior, but no interior groove.

Platynus fraterculus, n. sp.

Æneo-niger, nitidus, alatus; prothorace rotundato-quadrato, postice paulo angustiore, latitudine vix breviore, lateribus et basi late rotundatis, margine laterali anguste reflexo, angulis posticis obtusis, subrotundatis, licet sat distinctis, basi utrinque late impressa et subtiliter rugosa; elytris elongato-ovalibus, thorace paulo latioribus, striis subtilibus haud punctatis, punctis 3 dorsalibus, 1^{uno} in 2^{da}, alteris in stria 3^{ia} sitis.
Long. 7 millim.

One female. This species appears more nearly allied to *P. Harrisii*, Lec., than to any other in my collection, but differs by its much smaller size and by the absence of the impression near the posterior end of the fifth stria. It resembles in the form of the prothorax *P. frater*, Lec.*, but is smaller, and has the second dorsal puncture on the second stria, while in that species it is on the third.

ZACOTUS, nov. gen. (Broscini).

Zacotus Matthewsii.

Supra purpureo-cupreus, nitidus, subtus niger; capite obscure cupreo, fronte profunde impresso, lateribus et inter oculos valde rugoso; prothorace convexo, ovato, latitudine paulo longiore, postice angustato et pedunculato, lateribus versus basin sinuatis, linea dorsali profunda, impressionibus transversis parum distinctis; disco

* I am informed by Baron Chaudoir that *P. frater*, Lec., is the same as *Agonum brevicolle*, Dej. iii. 159. The latter, however, is described as having four dorsal punctures, while in many specimens of *P. frater* which I have examined I perceive but three. I am therefore inclined to believe that Dejean's species is only an individual variation of *P. fossiger*.

toto transversim rugoso, basi punctato; elytris elongato-ovalibus, convexis, thorace haud latioribus, striis subtilibus subpunctatis, interstitiis vage impressis, parce subtiliter rugosis, basi virescentibus, stria scutellari distincta puncto magno notata.

Long. 18 millim., lat. 5·5 millim.

I have seen but one badly preserved female of this most interesting addition to the North-American fauna. It evidently belongs to a different genus from any mentioned by Mr. Putzeys in his Synopsis of Broscini (Stettin. Ent. Zeitung, 1868, p. 306); but the palpi are wanting, and only a few joints of the antennæ and tarsi remain. I am therefore unable to characterize the genus any further than to say that it resembles somewhat in form *Promecoderus*, and that its place in the tabular arrangement of Mr. Putzeys would be in (*aa*, *gg*), probably next to *Miscodera* and *Broscosoma*. The mentum-tooth is moderately large, slightly rounded, and is scarcely perceptibly impressed at tip; the temporal suture is not visible. The first dorsal stria commences on the peduncle of the elytra, as in *Miscodera*; the scutellar stria is connected at the base with the second stria, and is marked at its hinder end with a large puncture. The first four joints of the antennæ are glabrous.

It gives me much pleasure to dedicate this very beautiful species to the enterprising explorers to whose energy and perseverance during the many privations to which travellers in North-western America are exposed we owe the valuable collection which forms the subject of the present memoir.

Patrobus.

Patrobus fulcratus.

Niger, nitidus, depressus; capite profunde biimpresso; prothorace quadrato-cordato, latitudine paulo breviore, postice modice angustato, lateribus rotundatis, angusto reflexis, versus basin late sinuatis, angulis posticis rectis, basi medio late emarginato, utrinque vix obliquo, foveis basalibus latis profundis, dense punctulatis, carina angulari vix distincta, linea dorsali profunda; elytris elongatis, parallelis, striis haud profundis vix punctulatis, 3ª punctis 3 dorsalibus notata; trochanteribus posticis elongatis, maris acutis.

Long. 11·5 millim.

One pair. In the male the hind trochanters are about half as long as the thighs, and nearly acute at tip; in the female scarcely shorter, and rounded at the tip.

This species belongs to a group thus far found only in Western North America, distinguished by the great length of the hind trochanters. In the depressed form of the body and

parallel elongate elytra, they resemble in appearance *P. angicollis*, Randall, and *P. aterrimus*, Esch., but differ by the eyes being less prominent, the head less narrowed behind, and the hind angles of the prothorax less prominent; the third and fourth joints of the front tarsi of the ♂ are scarcely narrower than the first and second, but, as in other species, are not furnished beneath with papillæ; in both sexes the front tarsi are broader and furnished beneath with more abundant long golden hairs than in the typical *Patrobus*, and the fourth joint is very distinctly emarginate.

Three species of this group are known to me, agreeing closely in form and sculpture, but differing chiefly in size, form of prothorax, and length of trochanters. They may be distinguished as follows:—

Patrobus trochantericus.—Prothorax scarcely wider than long, very slightly narrowed at base, sides feebly rounded in front of the middle, and slightly sinuate behind; hind angles rectangular, slightly dentiform, base broadly emarginate at the middle, oblique and subsinuate at each side near the angles; basal impressions broad, punctulate, not very deep; carina of angle feeble, limited by a distinct but short impression: hind trochanters of male nearly as long as the femur, much attenuated beyond the middle, and extremely narrow and sharp at the tip; of the female nearly half as long as the femur, rounded at tip. Length 13–14 millims. Fort Crook, Northern California (Dr. G. H. Horn).

Patrobus californicus, Motsch. Bull. Mosc. 1859, ii. 123.—Of the same size and general form as the preceding; but the basal impressions of the thorax are shallower, more distinctly punctured, and the carina and impression near the angle are wanting; the base is much more oblique at each side, and the angle is more dentiform. The male is unknown to me. The hind trochanters of the female are as in the preceding, narrowed towards the tip, which is rounded, and are about half the length of the femur. California (Col. Motschulsky).

Patrobus fulcratus, Lec., above described, differing by the deeper basal impressions of the prothorax, by the base being scarcely oblique on each side, by the angles, which are less prominent though more rectangular, and by the less elongated and less attenuated hind trochanters of the male.

Anisomera.

Anisomera recta.

Elongato-ovalis, æneo-nigra, subtiliter dense reticulata; prothorace longitudine plus triplo latiore, postice subangustato, lateribus an-

tice late rotundatis, versus basin paulo obliquis vix subsinuatis, angulis posticis rectis, basi truncato; elytris thorace vix latioribus, utrinque seriebus tribus punctorum solitis, externa minus distincta.

Long. 10 millim.

One male. The first three joints of the front tarsi are clothed beneath with an elongate oval brush of dense hairs.

This species differs remarkably from *A. cordata* by the prothorax being scarcely perceptibly narrowed behind; it, in fact, resembles in miniature a *Colymbetes* of the group *Meladema*; but the ungues of the hind feet are equal and moveable, and much longer and more divergent than in *Agabus*—precisely, in fact, as in *Anisomera cordata*.

Platycerus.

Platycerus cærulescens, Lec. Proc. Acad. Nat. Sci. Philad. 1861, p. 345.

A remarkably well-developed ♂ (14 millims. long excluding the mandibles) is contained in Mr. Matthews's collection: it is much larger than the type, which was found at Fort Tejon, California, but agrees with it in form and sculpture; it is easily distinguished from *P. quercus* by the beautiful purple-blue colour of the elytra, by the tooth on the upper edge of the mandibles near the tip being prominent, and by the apex not being dilated and subserrate, as in that species, but only slightly emarginate.

Ceruchus.

Ceruchus striatus, Lec. Proc. Ac. Nat. Sc. 1859, p. 55.

The only male of this species I have seen is one of the valuable acquisitions of Mr. Matthews: it is larger (16·5 millims. long) than *C. piceus*, as might have been anticipated from the larger size of the female; the elytral striæ are very strongly marked, as in the female, and the intervals convex and coarsely punctured; the frontal excavation is much smaller and more anterior than in *C. piceus* ♂; the mandibles are stouter, more curved, and the tooth at the middle of the upper edge is very much broader, its base extending nearly to the base of the mandible. In both sexes the middle thighs are furnished beneath with a large patch of long yellow hair; and in the male the middle tibiæ are also clothed with long yellow hair on the inner face from the middle to the tip—characters not observed in *C. piceus*, which has in those places only a few scattered hairs.

A fine male specimen, collected in El Dorado, co. Cala.,

agrees with the one above described in having the under surface of the middle femora and the inner surface of the middle tibiæ clothed with long hair, but differs in the frontal excavation being triangular, much larger and broader, the prothorax much more strongly punctured, and especially by the elytral striæ being very fine, the outer ones obsolete, and the intervals perfectly flat and coarsely punctured. The tooth of the mandibles rises nearly perpendicularly about one-third from the tip; the angle is nearly rectangular, and the upper edge nearly horizontal, extending nearly to the base, giving the appearance of a curved inner outline and great breadth to the hind part of the mandible.

These characters seem to indicate a distinct species, to which I would give the name of *C. punctatus*.

ODONTÆUS.

Odontæus obesus, Lec.

One well-developed male (10 millims. long). On account of the resemblance of sculpture, I refer it to this species, of which the female only was previously known to me by a single Californian specimen. The clypeus is more obtusely rounded in front than in the two species of Eastern America, *filicornis* and *cornigerus*, and somewhat less coarsely punctured; the horn is long and slender, as in them; the prothorax is similar in form, except that it is perhaps a little shorter and more narrowed in front; the medial excavation is broader than in *cornigerus* and almost as in *filicornis*; the anterior declivity is sparsely punctured, much less so than in the one last named; the lateral elevations are longitudinal and laminiform, as in that species, but the excavations at their base are smaller, more deeply indented and subtriangular, and the crest of the elevation, instead of being broadly rounded in the arc of a circle, is very distinctly and nearly rectangularly angulated and perpendicularly declivous in front. I may mention, in order that the three species may be readily distinguished by the notes here given, that this lateral elevation in *O. filicornis* is merely a subacute tubercle or cusp, and that the dorsal groove is deeper, narrower, and more strongly punctured.

The females of these species are scarcely to be distinguished, except by minute differences in form and sculpture, which are not very obvious without comparison.

CARDIOPHORUS.

Cardiophorus longulus, Lec.

Well-preserved specimens of this species are clothed with a

fine cinereous pubescence, as in *C. gagates*, from which it differs chiefly by its less convex prothorax and elytra, and less rounded sides of prothorax.

ELATER.

Elater anthracinus.

Niger, nitidus; pube brevi suberecta nigra parce vestitus, prothorace latitudine longiore, antice angustiore, angulis posticis elongatis, fortiter carinatis; disco convexo, fortiter sat dense punctato, punctis haud umbilicatis; elytris striis punctatis, interstitiis vix convexis, punctatis, et transversim subrugosis; tarsis piceis; antennarum articulis 2^{do} et 3^{tio} conjunctis sequente paulo longioribus, hoc 2^{do} vix latiore.
Long. 10 millim.

One pair. In the male the prothorax is narrowed from the base to the apex, with the sides broadly and obliquely rounded; in the female the sides are nearly parallel behind the middle, then rounded to the tip, and the elytra are more obtuse behind than in the male. This species is allied to *E. carbonicolor*, but is much larger, the prothorax is more strongly punctured, and the third joint of the antennæ is narrower. It also approaches very nearly to an Alaskan specimen of *E. nigrinus*, which, however, has the hind angles of the thorax *acutely*, not *feebly* carinate, as described by Candèze, Elat. ii. 475; it differs by its larger size and greater length of the third joint of the antennæ, which is distinctly longer than the second, and by the somewhat more elongate form, longer hind angles of the thorax, and black antennæ and feet.

LIMONIUS.

Limonius nitidicollis.

Nigro-æneus, nitidus, parce breviter nigro pubescens; fronte apice lato rotundato, margine anguste reflexo, inter antennas biimpresso; capite thoraceque parce distincte punctatis, hoc latitudine paulo longiore, antice vix angustiore, convexo, angulis posticis acutis, reflexis, carina brevi margini approximata, minus conspicua, basi medio brevissime canaliculato; elytris striis subtilibus impunctatis, interstitiis planis, biseriatim punctatis; antennarum articulis 2^{do} et 3^{tio} æqualibus, conjunctis 4^{to} paulo longioribus.
Long. 6 millim.

One pair. Similar in size and form to *L. quercinus*, but very different by the characters given above, and rather allied to *L. aurifer*, Lec., though quite distinct from that species.

Corymbites.

Corymbites triundulatus, Lec. Trans. Am. Phil. Soc. x. 457; Candèze, Elat. iv. 145.

Elater triundulatus, Randall, Bost. Journ. Nat. Hist. ii. 12.

A female specimen, much larger (11 millims. long) than those from Lake Superior and Maine, but which does not differ from them in form and sculpture. The middle angulated dark band is equidistant between the other two, instead of being nearer to the hinder one as in our eastern specimens; I do not think that this is a sufficient character to establish it as a distinct species, although the prothorax seems to be a little broader.

Corymbites fraternus.

Obscure æneus, nitidus, pube cinerea longiuscula vestitus; prothorace latitudine longiore, fortiter sat dense punctato, angulis posticis elongatis, obliquis at vix divaricatis, breviter carinatis; elytris striis angustis vix punctatis, interstitiis planis, punctatis; antennis pedibusque piceis vel piceo-ferrugineis, illis articulo 3tio secundo paulo longiore at vix latiore, conjunctis 4to haud longioribus. Long. 15–17 millim.

One pair. In the male the prothorax is gradually narrowed and feebly rounded on the sides from the base to the apex; in the female the body is more robust, the sides of the prothorax are nearly parallel behind, and more strongly rounded before the middle.

This species is very closely allied to the Alaskan *C. angusticollis*, but differs chiefly by the hind angles of the prothorax, which are not so narrow and are scarcely divaricated.

Asclera.

Asclera nigra.

Cyaneo-nigra, opaca, brevissime pubescens; prothorace obovato, postice angustato, latitudine vix longiore, dense punctulato, apice subsinuato, basi late rotundato, apice subconstricto, lateribus medio rotundatis, postice late sinuatis, disco subtiliter punctulato, foveis tribus latis impresso, ante medium subcarinato; elytris confertissime punctatis, lineis utrinque tribus angustis elevatis. Long. 9 millim.

One specimen. Resembles somewhat the European *A. cœrulea*, but differs by the much deeper excavations of the prothorax: it agrees in form and sculpture with the Californian *A. excavata*, Lec.; but the thorax in that species is rufous, more elongate, and much less punctured than in the present one.

DYSLOBUS, Lec.

I have associated under this name several species found in Western North America which belong to the tribe Eremnini of the Oxyophthalm Adelognath Curculionidæ, according to the arrangement of Prof. Lacordaire. They differ from the other genera known to me by the following assemblage of characters :—

Rostrum slightly dilated at tip, rather thick, flattened above, feebly carinate, with the apical lobes divergent; postocular lobes of thorax more or less ciliate, and very feebly developed, though still quite apparent. The general appearance is that of *Otiorhynchus*, from which this genus differs by the form of the eyes, narrowed and angulated beneath, by the less elongated scape of the antennæ, and the postocular thoracic lobes.

To this genus belong :—

Otiorhynchus segnis, Lec.

Dyslobus granicollis.

Niger, squamulis griseis et fuscis dense vestitus et breviter brunneo pubescens; thorace latitudine paulo longiore, antice vix angustiore, lateribus rotundatis, apice et basi subtruncatis vix rotundatis, angulis omnibus obtusis, dorso transversim convexo, dense subtilius rugose punctato et granulato; elytris convexis, ovalibus, thorace duplo latioribus, apice valde declivibus, striis haud impressis e punctis magnis compositis, interstitiis 3^{a}, 5^{a}, et 7^{a} paulo elevatis et maculis obscuris variegatis.

Long. 10 millim.

Vancouver's Island and Puget Sound (Mr. G. Davidson).

The beak is a little longer than the head, not narrower than the front, nearly parallel on the sides, very feebly dilated at tip; upper surface flattened, carinate from the base to between the antennæ, where the carina ends in an elongate fovea. The antennal grooves are short and oblique; and under them on each side is a strongly impressed oblique line, nearly uniting in the gular transverse impression. The front is broadly transversely impressed at the base of the rostrum. The scales of the occiput are tinged with metallic colours. The prothorax is scarcely one-half wider than the head, a little longer than its width, broadly rounded on the sides, very feebly rounded and nearly truncate at base and tip; the surface is densely rugosely punctured, and between the scales presents small shining granules. The elytra are nearly twice as wide as the thorax, and about twice as long as their width, oval, convex, very declivous behind; the striæ are composed of large shallow punctures, not closely placed; and the third, fifth, and seventh intervals are slightly elevated and darker in colour.

The scape of the antennæ is slender and extends to the back part of the eyes; the funiculus is slender, and longer than the scape; the first and second joints are equal and elongate, the third is two-thirds as long as the second, the fourth, fifth, and sixth equal, each a little shorter than the third, the seventh a little longer; club elongate-oval, acute at tip. The first ventral suture is distinct and straight, the second and third are deeply exarate; the last ventral segment is convex towards the tip, and the extreme tip is carinated and acute.

In *D. segnis* the third joint of the funiculus of the antennæ is scarcely shorter than the second, the carina of the rostrum is very feeble, almost obsolete, and the lateral oblique lines below the antennal grooves are entirely wanting.

Dyslobus decoratus.

Niger, squamis obscure argenteis et cupreo-fuscis variegatus, parce breviter pubescens, rostro subcarinato; thorace latitudine haud longiore, antice subangustato, lateribus rotundatis, apice basique fere truncatis, angulis omnibus obtusis, disco transversim convexo, profunde rugose punctato et granulato; elytris thorace latioribus, elongato-ovalibus, apice rotundatim valde declivibus, striis e punctis magnis magis approximatis compositis.

Long. 7 millim.

Vancouver's Island.

Smaller and somewhat more robust than *D. granicollis*, but apparently congeneric with it; the carina of the rostrum is more feeble, and does not end in an anterior elongate fovea; the lateral oblique lines below the antennal grooves are distinct; the funiculus of the antennæ is rather stouter, and the third joint is not longer than the following, which are nearly as broad as they are long; the elytral striæ are feebly impressed and composed of more approximate large punctures.

Two other species of this genus are before me—one from Oregon, one from California, which await description when a general synopsis of the Curculionidæ of the United States is prepared.

Tyloderes? gemmatus, Lec.

is related to *Dyslobus*, but differs by the beak being more slender, much more dilated at tip, and by the antennal grooves being longer and deeper. The first and second joints of the funiculus are elongate, the third to the seventh are nearly equal in length, except that the fifth is a little shorter. The postocular lobes of the prothorax are equally broad, but more prominent and less fimbriate. The first ventral suture is deep, and feebly convex forwards at the middle; the other three are straight

and deeply exarate; the last ventral segment is not convex, nor subcarinate at tip. The thorax and elytra are studded with scattered, large, polished granules or small tubercles, and the striæ are not apparent. These differences are apparently generic; but I am unwilling at present to do more than propose the name *Phymatinus*, and to indicate it as probably belonging to the group Phytoscaphi, Lac. Gen. vi. 229.

In all the species here mentioned, the apical cavities (corbeilles) of the hind tibiæ are broad, oblique, acutely margined and open at their upper limit; and the antennal grooves, though oblique, are not directed below the inferior angle of the eyes. They also all belong to a great division of Curculionidæ (embracing the greater part of Lacordaire's Adélognathes, with some of the short-beaked Phanérognathes, such as *Eudiagogus*, among our North-American forms), which exhibits a remarkable character, not known in any other group of Coleoptera: the mandibles of the freshly developed imago have acute pyramidal appendages, which are deciduous, and leave a well-defined scar on the most anterior part of the convex outer surface of the organ. This peculiar structure has been mentioned by Lacordaire (Gen. vi. p. 5, note), but without attributing to it the importance which such an extraordinary character, common to a large number of genera, and without parallel in any other part of the series, seems to deserve. I have placed, in an unfinished continuation of my 'Classification of the Coleoptera of North America,' all such forms together as a subfamily, under the name Brachyderidæ. *Sitones* and allied forms do not belong to this type, as the mandibles are not provided with the deciduous appendage, nor does the mentum cover the base of the maxillæ.

TETROPIUM, Kirby.

Tetropium velutinum.

Nigro-piceum, opacum, subtiliter sericeo pubescens; prothorace latitudine haud breviore, lateribus fortiter rotundatis, disco confertissime punctulato, sulco dorsali lato profundo, linea lævi polita versus basin notato; elytris basi nonnunquam piceo-ferrugineis. Long. 12·5–20 millim.

Four female specimens from Vancouver's Island, Oregon, and California differ from *T. cinnamopterum*, Kirby, found in Eastern America, by the prothorax being not wider than long, and more finely and densely punctulate. This difference appears to me to be specific, though I have not studied the group with a sufficient number of specimens to give my opinion much value.

Necydalis.

Necydalis lævicollis.

Capite thoraceque nigris, hoc latitudine paulo longiore, convexo, nitido, fere impunctato, dorso vix canaliculato, antice posticeque transversim impresso, lateribus medio late rotundatis utrinque vix subsinuatis; elytris obscure ferrugineis, rugoso punctulatis, apice piceis et transversim profunde impressis; abdomine supra piceo, infra ferrugineo, pectore nigro; pedibus obscure ferrugineis; antennis nigro-piceis.

Long. 16 millim.

One specimen. Differs from *N. mellitus* of Eastern America by the more robust and nearly smooth prothorax, which is scarcely sinuated on the sides, and by the elytra being much more deeply impressed near the tip.

Leptura.

Leptura fuscicollis, Lec. Pac. R.R. Expl. & Surveys, Ins. p. 65.

Elongata, æneo-nigra; capite thoraceque confertissime subtiliter punctatis, hoc transversim profunde bis constricto, lateribus medio angulatis, dorso canaliculato et linea lævi notato; elytris basi thorace latioribus, ab humeris sensim angustatis, apice rotundatis, vix subtruncatis, confertim fortiter punctatis, pube brevissima parce vestitis, nigris, margine laterali, basali et apicali vittaque angusta dorsali testacea ornatis; pedibus fuscis, femoribus rufis, anticis supra, posterioribus apice fuscis.

Long. 12 millim.

Variat testacea, subænea, capite thoraceque fusco-æneis, elytris vitta lata submarginali paulo obscuriore. (Lec. Pac. R.R. Expl. and Surveys, Ins. p. 65.)

A fully matured specimen from Vancouver's Island evidently belongs to the same species as the pale-coloured specimen from California previously described by me. It is allied to the Alaskan *L. Frankenhaeuseri* and *macilenta*, and, apart from differences in the colour, which I regard as of no importance, only differs from them by the larger size, and the convex part of the disk of the prothorax not being foveate on each side of the dorsal channel.

The two larger specimens are both females, and differ from the male types of the Alaskan species by the more slender and less elongated antennæ, and by the more distinctly emarginated eyes. I am inclined, in view of the great differences in colour observed in certain species of *Acmæops*, to regard these three forms as merely varieties of one species. They belong to a

group of the genus which, from the slender outline and the peculiar conformation of the prothorax, bears a strong resemblance in miniature to *Toxotus*.

I may further observe that the elytra of the specimen above described may be equally well said to be pale, with a broad black sutural stripe, and a broad black dorsal vitta extending from the humeri nearly to the tip.

Leptura scripta.

Elongata, fusca, parce pubescens; capite thoraceque confertim subtilius punctatis, hoc apice angustiore, tubulatim profunde constricto; basi transversim impresso, lateribus medio rotundatis, subangulatis, antice posticeque concavis, angulis posticis haud prolongatis; elytris fortius punctatis, thorace latioribus, parallelis, apice rotundatis subtruncatis, pallide testaceis, lituris nigris ornatis (viz. striga angusta discoidali a basi fere ad medium extensa, macula laterali duplici ad medium, alterisque duabus approximatis ad dodrantem, exteriore submarginali); antennis pedibusque testaceis, femoribus posticis extrorsum late infuscatis.
Long. 10 millim.

One female. Belongs to the same group as *L. sphæricollis*, and related in form and sculpture to *L. aurata*, but quite distinct by the peculiar coloration. The black markings of the elytra above mentioned are a narrow line extending from the base to about the middle, slightly oblique and gradually narrowed behind, a lateral or submarginal spot at the middle, composed of two confluent spots, and an imperfect band behind the middle, half way between the spot just described and the tip; this band is composed of an elongate submarginal spot and a smaller discoidal one; there is, besides, a very faint fuscous cloud on the side margin near the base: the scutellum and the suture for a short distance are also black.

Leptura Matthewsii.

Nigra, pubescens; elytris a basi paulo angustatis, confertim subtilius punctatis, flavo-testaceis, apice late et macula magna pone medium ad marginem extensa nigro-piceis, apice singulatim rotundatis rufescentibus; prothorace latitudine breviore, apice valde angustato et fortiter tubulatim constricto, lateribus obtuse angulatis, pone medium fere parallelis, angulis posticis brevibus acutis, basi late bisinuato, disco confertissime fortiter punctato, ante basin profunde transversim impresso.
Long. 20 millim., lat. 7 millim.

One female. Somewhat related to *L. cordifera*, but much larger, therefore resembling *L. obliterata* and *vitiosa*, which,

however, belong to a different group, having the elytra bidentate at tip. This species differs conspicuously from *L. cordifera* and its allies by the tubular constriction of the apex of the thorax being very well marked and longer than usual, and by the base being less prolonged at the middle and more broadly bisinuate; the posterior impression extends entirely across the base, and is very strongly marked and nearly straight.

In the name of this fine and conspicuous species I desire to commemorate the labours of Messrs. Henry and Joseph Matthews, who, inspired by the same love of science to which we owe many valuable memoirs in entomological literature by their brother, the Rev. A. Matthews, have with great zeal explored the wildernesses of British Columbia and Vancouver's Island, and, in fact, have obtained the best material yet procured for a study of the distribution of species in those regions, which remain, in a scientific sense, the most unexplored portions of North America.

ATIMIA, Hald.

Atimia dorsalis.

Nigro-picea, pube brevi depressa fulvo-sordida dense vestita; thorace latitudine vix breviore, quadrato, ad apicem subito angustato, lateribus haud rotundatis, modice punctato, vitta dorsali lata subnuda; elytris antice parce punctulatis, vitta denudata subsuturali pone medium extrorsum bidentata, et sensim angustata notatis.

Long. 10 millim.

Vancouver's Island. A specimen was also collected in Southern California by Dr. G. H. Horn.

This species is very closely related to *A. confusa* (*Clytus confusus*, Say, *A. tristis*, Hald.), but differs by the prothorax being less transverse, almost quadrate, and scarcely rounded at the sides, except near the apex, where it is suddenly narrowed: the arrangement of the denuded spots is somewhat similar; but the sides of the thoracic vitta are straight and the elytral spots are confluent, forming a vitta extending nearly to the tip, with two external dilatations—one at the middle, the other at the extremity; the tip of the elytra is more squarely truncate, and the general form a little less robust than in *A. confusa*.

XLV.—*On the Nomenclature of the Foraminifera.* By Prof. T. Rupert Jones, F.G.S., W. K. Parker, F.R.S., *and* J. W. Kirkby, Esq.

[Plate XIII.]

Part XIII. *The Permian* Trochammina pusilla *and its Allies**.

§ I. A minute serpuloid fossil occurring abundantly in the Permian Limestone of the British Islands and Germany attracted the notice of palæontologists twenty years ago. Its tubular and variously contorted shell suggested an Annelidan relationship, though its minute size seemed to contradict that notion. Prof. W. King had, however, from the first, formed the idea of its being related to the Foraminifera; but no near ally among the existing Rhizopods was recognized until 1856, when one of us referred it to "*Spirillina*," which was then supposed to include both opaque and transparent monothalamous shells, either discoidal or twisted †. In 1857 all these together were spoken of as "the *Spirillinæ* [hyaline], *Cornuspiræ* [opaque], and their allies," common in the recent and the fossil state, and as including the minute fossils from the Magnesian Limestone that we have here to treat of (Ann. Nat. Hist. ser. 2. vol. xix. p. 285, & note). Further distinctions had been made by 1860, when the opaque forms were subdivided—some left to *Cornuspira* and others placed with *Trochammina*, the little Permian fossil being provisionally referred to the latter (Quart. Journ. Geol. Soc. vol. xvi. p. 305, note). A similar intimation of its alliance is given in Carpenter's 'Introd. Foram.' (Ray Soc.), 1862, p. 142, and in the 'Monograph of the Foraminifera of the Crag' (Palæont. Soc.), 1866, p. 26. Finally, one of the varieties of this protean Microzoan is so much like a *Miliola* that one of us referred to it, a few years back, as *Miliola? pusilla* ‡.

§ II. Frequently this little fossil occurs as casts in the limestone (as at Humbleton, near Sunderland), and most usually as an oblong coil of white, calcareous, subcylindrical, wire-like folds, with appreciable intervals, especially between the larger, outer folds. A central, irregularly twisted, tubular mass, of about $\frac{1}{50}$ inch in diameter, is enclosed in eight or nine outer folds; these are flat or slightly concave on their

* The last Part of this Series of Papers was inadvertently entitled "Part X. (continued)" instead of "Part XII." See Ann. Nat. Hist. ser. 3. vol. xvi. p. 15.

† In 1854 the discoidal forms alone were referred by one of us (in Morris's 'Catal. Brit. Foss.' 2nd. edit. p. 42) to "Spirillina."

‡ 'Synopsis of the Geology of Durham and part of Northumberland,' by R. Howse and J. W. Kirkby, p. 18. 8vo, Newcastle, 1863.

inner and convex on their outer face, and are arranged longitudinally, not all on the same plane, but, with the exception of the outermost folds (which are more nearly parallel), crossing one another at the extremities of the coil at various angles. The size of the folds gradually increases from within outwards, but is subject to irregularities sometimes suggestive of periodic constrictions or undeveloped segmentation. The whole fossil is about $\frac{1}{20}$ inch long, and $\frac{1}{70}$ in breadth and thickness.

Shelled specimens of this kind are abundant in the Magnesian Limestone of Yorkshire ("Lower Limestone," in an old quarry beside an inn called the Hampole Inn), and in the Zechstein of Germany at many places. It is this form which was noticed by Geinitz under the name of *Serpula pusilla*, and by King as *Foraminites serpuloides*.

§ III. These irregularly coiled varieties are accompanied by others that have a more discoidal arrangement of the whorls, which, in this case, fold over and over on one plane or nearly so, making a flatter shell, more or less oval, and leading us as it were to the regularly discoidal narrow-whorled form which was described by one of us, in 1850, as a "*Spirillina*" (in King's 'Monograph of Permian Fossils,' p. 18). The specimen then referred to was from Tunstall Hill, near Sunderland; others have been met with in the Lower Magnesian Limestone of Langton, co. Durham, and elsewhere.

§ IV. Another form of the same kind of shell as the first-mentioned (§ II.) has thicker folds, arranged more flatly on one plane, in an oblong coil, and enveloping one another on their edges, but sometimes showing, on the flatter faces, parts of the early whorls, and thus much resembling some Milioline shells. This is especially abundant near the Hampole Inn above mentioned; and, judging from the section of a shell given as fig. 19, in pl. 10 of Geinitz's 'Dyas,' we presume that it is not wanting in Germany. Among the specimens from Yorkshire, some of the Milioloid varieties become oval, and even circular, differing from the discoidal forms of *Tr. pusilla* only in having thicker, broader, and fewer whorls.

§ V. In 1856 one of us discovered numerous minute "arenaceous" Foraminifera in the shelly sands of the Indian seas, which presented in their contorted tubular forms the required recent analogue of the Permian fossil. Although, indeed, the majority of those first found have a tendency to fold more irregularly than the then known fossil specimens, yet others of the latter have since been abundantly met with, in which the almost discoidal outer folds are disposed to pass for a little way on one of the flatter surfaces of the shell, and then return to their original plane, or even to pass round about

the former whorls of the shell at various angles. On the other hand, the recent contorted forms are associated with others of similar structure and habit, but more or less discoidal in their mode of growth, leading us towards both *Trochammina incerta* (D'Orbigny, sp.) and *Tr. inflata* (Montagu, sp.); and, indeed, all these and other varieties were, in 1860, included under the "second species" of *Trochammina* *, as being zoologically related to the typical *Tr. squamata*; but, of course, the necessity of retaining binomial appellations for well-marked varieties, recent and fossil, must be always recognized. For these chief varieties, then, the names *Tr. incerta* (D'Orb.), *Tr. charoides* (P. & J.), *Tr. gordialis* (P. & J.), *Tr. squamata* (P. & J.), and *Tr. inflata* (Montagu) were adopted †.

In a paper "On the Occurrence of Foraminifera in the older beds of the Vienna Sandstone," F. Karrer has given excellent figures of his *Trochammina proteus* ‡ from these strata of Cretaceous or Lower-Tertiary (?) age. Among these figures we find modifications of *Tr. gordialis* (figs. 1, 2, 3, 8), of *charoides* (fig. 4), of *squamata* (fig. 6), and irregular *squamata*, or transitional from lobulate *gordialis* to *squamata* (fig. 5). The Spirilline or discoidal and narrow-whorled condition (*Tr. incerta*), from the same beds, is given as *Cornuspira Hoernesi* (fig. 10).

§ VI. With some of the above-mentioned recent and fossil forms the different specimens of the little Permian fossil under notice are readily correlated. Thus the perfectly discoidal narrow-whorled individuals come in the same group with *Tr. incerta*; and very similar Rhizopods, having plano-spiral shells of sandy texture, have been figured and described from several geological formations, and have received different names, as shown in the following list:—

Recent. *Operculina incerta*, D'Orbigny, 1839. Foram. Cuba, p. 49, pl. 6. figs. 16, 17.

Lower Cretaceous. *Operculina cretacea*, Reuss. 1846. Verstein. Böhm. Kreid. p. 35, pl. 13. figs. 64, 65.

Lias. *Orbis infimus*, Strickland, 1848. Quart. Journ. Geol. Soc. vol. ii. p. 30, fig. *a*.

Permian. *Spirillina*, sp., Jones, 1850. In King's Monogr. Perm. Foss. pp. 18–20; and in Morris's Catal. Brit. Foss. 2nd edit. p. 42.

Chalk and Chalk-marl. *Spirillina cretacea*, Jones, 1854. In Morris's Catal. Brit. Foss. 2nd edit. p. 42.

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* Quart. Journ. Geol. Soc. vol. xvi. p. 304. The "first species," or simplest form, has been since referred to the restricted genus "*Webbina*," D'Orb.

† *Op. cit.*, and in Carpenter's 'Introd. Foram.' p. 141, pl. 11. figs. 1–5.

‡ Sitz. Akad. Wien, Math.-Nat. Classe, vol. lii. 1st Abtheil. 1865, pl. 1. figs. 1–8.

Lias. *Spirillina infima*, Jones, 1854. *Ibid.*
London Clay. *Spirillina*, sp., Jones, 1854. *Ibid.*
Recent. *Spirillina arenacea*, Williamson, 1858. Rec. Foram. Brit. p 93, pl. 7. fig. 203.
Recent and Fossil. *Trochammina (squamata) incerta*, Jones & Parker, 1860. Quart. Journ. Geol. Soc. vol. xvi. p. 304.
Recent and Fossil. *Ammodiscus* (species), Reuss, 1861. Sitzungsb. Akad. Wien, vol. xliv. (Zusam. Foram.) p. 365.
Recent and Fossil. *Trochammina incerta*, Parker & Jones, 1862. In Carpenter's Introd. Foram. p. 141 & p. 312, pl. 11. fig. 2.
Lower Cretaceous. *Cornuspira cretacea*, Reuss, 1862 (Sitzungsberichte Akad. Wien, vol. xlvi.). Foram. Hils und Gault &c. p. 34, pl. 1. fig. 10, and var. *irregularis*, figs. 11 & 12.
Tertiary (?). *Cornuspira Hoernesi*, Karrer, 1866 (Sitzungsb. Akad. Wien, vol. lii.), Auftreten Foram. &c. p. 4, fig. 10.
Permian. *Serpula Roessleri*, Schmidt, 1867. N. Jahrb. 1867, p. 583, pl. 6. figs. 46, 47.

For the distinctive name of this Permian Rhizopod the appellation *Trochammina incerta* (D'Orb.) has priority; whilst zoologically (that is, looking only at its real specific relationship, and taking the *gradations* of form as varietal) it belongs to the typical *Tr. squamata*. For convenience of reference, however, this Foraminifer (Pl. XIII. fig. 1), as in other cases, keeps a distinct name; and we must remark that, as a *Permian* organism (if its geological age and position are to be regarded as of any special importance), it first received its trivial name (*Roessleri*) from Dr. E. E. Schmidt (1867).

A variety, in which the tube departs, at an early stage, from the spiral to the straight line of growth (this occurs with very many Foraminifers), has been recognized and figured, as *Serpula filum*, by Dr. E. E. Schmidt, *op. cit.* p. 583, pl. 6. fig. 48, who has associated it with the spiral form (both being regarded by him as Serpula-tubes), because it also is free and not parasitic.

§ VII. Less regular in its coil, and with a somewhat broader whorl, a closely allied form of this fossil *Trochammina* accompanies the foregoing, and is figured in the annexed Plate XIII. figs. 2 & 3. Still more irregularly folded are figs. 4, 5, & 6, which represent the well-known "*Serpula pusilla*" of Geinitz, the special subject of this notice (see above, § II.). Regarding these as representing a form requiring a distinctive name, though zoologically linked with fig. 1 (by means of figs. 2 & 3), we must, of course, use the long-established trivial name above quoted, and refer to the fossil as *Trochammina pusilla*, Geinitz, sp. We have already remarked that this, with the Spirilline variety, has been included in the zoological species *Trochammina squamata*.

The synonyms of *Trochammina pusilla* are as follow :—

Serpula pusilla, Geinitz, 1848. Verstein. Zechst. Roth. p. 6, pl. 3. figs. 3–6.
Foraminites serpuloides, King, 1848. Cat. Perm. Foss. Northumb. p. 6.
Serpula? pusilla, Jones, 1850. In King's Monogr. Perm. Foss. p. 57, pl. 6. figs. 7–9; pl. 18. figs. 13 *a–d*.
Serpula pusilla, Morris, 1854. Cat. Brit. Foss. 2nd edit. p. 93.
Spirillina pusilla, Jones, 1856. In King's Memoir on Irish Permian Fossils, Journ. Geol. Soc. Dublin, vol. vii. part 2. p. 73, pl. 1. figs. 12 *a*, *b*.
Serpula pusilla, Geinitz, 1861. Dyas &c. p. 39, pl. 10. figs. 15–21, & pl. 12. fig. 1.
Serpula pusilla, Bölsche, 1864. Neues Jahrb. Min. &c. for 1864, p. 667.

§ VIII. Many *Trochamminæ* (*Tr. gordialis* and *Tr. charoides*) from the warm seas resemble *Tr. pusilla*, but more especially in its earlier stage of irregular coiling; and we find individuals of this stage of growth or knot-like condition in the Permian limestone also (see figs. 7, 8); and we can refer to them as *Tr. gordialis*, the synonyms of which are as follow :—

Trochammina (squamata) gordialis, Jones & Parker, 1860. Quart. Journ. Geol. Soc. vol. xvi. p. 304. (*Spirillina pusilla*, Jones, is referred to in the footnote at p. 305.)
Trochammina gordialis, Parker & Jones, 1862. In Carpenter's Introd. Foram. p. 141.
Trochammina squamata, var. *gordialis*, Parker & Jones, 1865. Phil. Trans. vol. clv. p. 408. (Reference is here made to the similarity of the so-called *Serpula pusilla*.)
Trochammina proteus, Karrer, 1866. Ueber das Auftreten von Foraminiferen in den alteren Schichten des Wiener Sandsteins (Sitzungsb. Akad. Wien, vol. lii.), p. 3. figs. 1–8. (Including *Tr. gordialis*, *Tr. charoides*, *Tr. squamata*, and intermediate conditions.)
Trochammina squamata, var. *gordialis*, Parker, Jones, & Brady, 1866. Monogr. Foram. Crag, p. 26. (Reference is here made to *Spirillina pusilla*, Jones, and *Miliola? pusilla*, Kirkby.)

§ IX. In fig. 9, Pl. XIII., we see broad short whorls making a shell that somewhat reminds us of the Biloculine *Miliolæ*. Still more neatly and compactly arranged, the folds constitute a flattish and nearly oblong shell (fig. 10), or a broadly oval and almost biconvex shell (fig. 11), or even a circular shell with sunken faces (fig. 12). In figs. 13 & 14, the exposure of a circumscribed oval portion of the older whorls in the middle of the side-faces of the subovate shell gives it a particularly Milioline likeness, reminding us of *Triloculina* and *Quinqueloculina*. Hence one of us thought it likely to prove a *Miliola*, and referred to it as *M.? pusilla*; but now we give to this variety the name of *Trochammina milioloides*. The nearest published drawing is Herr Karrer's fig. 2 of *Tr. proteus*; and indeed it is essentially the same, though showing a greater

exposure of the early whorls, and thus constituting a passage-form between *Tr. gordialis* and *Tr. incerta* in one direction, as *Tr. pusilla* is a link in another.

We may here remark that *Trochammina squamata* (*typica*) has a very near relationship to *Valvulina* in structure and habit, though it possesses more chambers and wants a definite tongue-like appendage at the orifice. This alliance has been suggested to us by our friend and colleague, Mr. H. B. Brady, F.L.S., whose collection of these Foraminifera particularly exemplifies their many intermediate gradations of form. So also *Tr. inflata* sometimes seems to become *Lituola canariensis* by the increased coarseness of its shell and its more compactly nautiloid shape. Indeed there is no real specific, much less generic, distinction between all these and many other associated forms, if such distinctions fade away as gradations of intermediate styles of structure and shape become more and more known.

Again, though the *Miliolæ* have for the most part a homogeneous calcareous shell, yet many become coated with a sandy envelope, and, except in the possession of a tongue or valve at the aperture, may be lineal descendants and representatives of such forms as are here figured in Plate XIII. figs. 9–14; whilst *Cornuspira* and *Spiroloculina*, in particular, may in like manner be descended from such as figs. 1–3.

Whether or not the tongue-like process in *Miliola* and the valve in *Valvulina* are essential distinctions, there is no doubt that there is a considerable range of variation in the shell-structure produced by these and other simple Protozoans, and that it is difficult to distinguish the limits between coarseness and fineness, roughness and smoothness, when the amount of sand in the shells of some forms (*Valvulina*, *Miliola*, *Bulimina*, *Textularia*, &c.) varies from much to nothing.

§ X. *Trochammina pusilla* is very widely and very plentifully distributed in the Permian rocks of England and Germany. In Durham it ranges from the lowest beds to the middle of the Magnesian Limestone. It is absent in the highest beds. In Yorkshire it only occurs in the lower beds of the series.

It usually occurs as casts; sometimes (in hard subcrystalline limestone) it is seen as sections showing internal structure, and occasionally as well-preserved testiferous specimens.

In Durham it is found in the "Shell-limestone" at Tunstall Hill, Humbleton Hill, and Claxheugh, near Sunderland.

In the "Lower Limestone" of the same county it occurs at Hartley's Quarry and Pallion near Sunderland, Westoe, Offerton, Rough Dene, Eldon, Langton, Morton Tinmouth, Sum-

merhouse, Thrislington Gap, Running Waters, Moorsley, Walworth and Limekiln Banks, south of Leg's Cross.

In Yorkshire it is very abundant, occurring, with the Milioloid variety, in myriads, in the dark-grey limestone of Nosterfield, and in a similar limestone at Chapel Houses,—also at Gybdykes, near Masham, Thornton Watlass, Linderick, and Hampole.

In Ireland it has been found by Prof. W. King at Tullyconnel Hill, near Artrea, co. Tyrone.

In Germany it is very common in the Lower Zechstein of Corbusen, near Ronneburg, and at other places in the vicinity of Gera, at Moderwitz (near Neustadt) on the Orla, at Kamsdorf and Saalfeld, and in the Wetterau ('Dyas,' p. 40). It is found also in the "grauer Mergel-Zechstein," overlying the Zechstein at Gera (King, Journ. Geol. Soc. Dublin, 1856).

The discoidal or *Spirillina*-like form (*Tr. incerta*) is found in Durham in "Shell-limestone" at Tunstall Hill, and in "Lower Limestone" at Langton, Thrislington Gap, Walworth, and Limekiln Banks, south of Leg's Cross.

The Nosterfield limestone, when cut and polished, shows instructive sections, the matrix being almost black, while the shell-substance is white. This rock is similar to the black limestone of Gera and Hanau.

This little fossil is always associated with other fossils, such as *Producta horrida*, *Gervilia antiqua*, and *Ichthyorachis anceps*, often with other Rhizopods, and as often with an obscure plant-like fossil which has been named *Chondrus virgatus*. It is always free (not attached or parasitic); and we do not see any reason to follow Dr. Geinitz* in associating the fixed vermiform fossil (*Vermilia obscura*, King) with *Trochammina pusilla*.

EXPLANATION OF PLATE XIII.

Fig. 1. *Trochammina incerta*. From Langton, co. Durham. Magnified 30 diameters.
Figs. 2, 3. *Tr. pusilla*, subdiscoidal forms. Sunderland. Magn. 15 diams.
Figs. 4, 5, 6. *Tr. pusilla*, ordinary forms. Sunderland. Magn. 15 diams.
Figs. 7, 8. *Tr. gordialis*. Tunstall Hill, Sunderland. Magn. 15 diams.
Figs. 9–14. *Tr. miliolides*, various forms. Sunderland. Magn. 10 diams.
Fig. 15. *Tr. pusilla*, section. Nosterfield. Magn. 15 diams.

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* 'Dyas,' p. 39. In the 'N. Jahrbuch &c.' for 1864, p. 667, Herr Bolsche also noticed a serpentine form, parasitic on shells &c., and intimated that it and King's *V. obscura* may be the same as, or varieties of, the coiled form.

XLVI.—*Observations on the Parasitism of* Rhipiphorus paradoxus. By Frederick Smith, Assistant in the Zoological Department of the British Museum.

Every entomologist will read Mr. Murray's paper on *Rhipiphorus* with great interest; I have certainly done so, because I had been obligingly informed by the author of the aim he had in view, that of proving the larva of *Rhipiphorus* to be, as the American entomologists have happily termed it, "a guest-insect" whose larva feeds upon the food supplied by the wasp, and not a parasite that preys upon its larva.

I had certainly considered that the habit of the larva of *Rhipiphorus* had been clearly established by Mr. Stone five years ago; I therefore looked forward to the publication of Mr. Murray's paper with great interest.

When I refer back to the correspondence which I possess from Mr. Stone, and refresh my memory by so doing, I at once confess myself satisfied as to the habit of *Rhipiphorus*, and still believe its larva to be a carnivorous parasite.

I had the pleasure to hold a most interesting correspondence with Mr. Stone relative to the habits of the wasp and its parasites, during a period of about six years, and so am satisfied as to his accuracy of observation, his most scrupulous adherence to facts, and facts alone; for he never indulged in theory; he was a plain straightforward observer, indefatigable in the search after truth, and unremitting in his attention to the most minute details in all his investigations.

It appears to me only necessary to read a single paragraph in a communication which I had the pleasure of laying before the Entomological Society, on Mr. Stone's behalf, to convince any person of the habit of *Rhipiphorus*; it is as follows:—

"On the 19th of August I was more fortunate; for on taking out a nest of *Vespa vulgaris*, and proceeding to open the closed-up cells, I found a larva of the parasite firmly attached to the full-grown larva of the wasp, the mouth of the former buried in the body of the latter just below the head, its neck bent over that of its victim, whose body appeared to be tightly compressed by that of its destroyer, showing the latter to be possessed of a considerable amount of muscular power. It was of minute size when discovered, and appeared to have only very recently fastened upon its victim; but so voracious was its appetite, and so rapid its growth, that in the course of the following forty-eight hours it attained its full size, having consumed every particle of its prey, with the exception of the skin and mandibles, which, from observations I have since been enabled to make, these creatures retain in their grasp

even after they have passed into the pupa state. They scarcely appear to cease eating, except now and then for a minute or so, from the time they first begin to feed till they have become full-grown."

Thus we learn that Mr. Stone's observation was not confined to that of the single larva "attached to the full-grown larva of the wasp;" on the contrary, from subsequent observations, he was enabled to ascertain that these creatures, in the pupa-state, retain in their grasp the skin of their victims.

Again, he says, "I took out thirteen more nests of *V. vulgaris*, which contained examples of *Rhipiphorus*, either in the larva-, pupa-, or perfect state. In one that had been destroyed by means of gas-tar a few days before, I was fortunate in discovering a small larva of *Rhipiphorus* firmly attached to its victim: both were dead, and had become partially dried; so that when immersed in spirits they did not separate, but remained attached just as they were before death.

"Another nest was taken out on the 2nd of September; and on a closed cell being opened, that was appropriated to a queen, a larva of *Rhipiphorus* was discovered; an adjoining cell contained a pupa; both these were about double the size of larvæ and pupæ found in cells of worker wasps."

Shortly after the publication of Mr. Stone's paper in the 'Zoologist,' vol. xxiii. (1865), that gentleman presented to me the whole of the collection he had made of larvæ and pupæ alluded to in his paper. I have before me a small phial containing the larva of the wasp that has that of its destroyer firmly attached to it, as mentioned above; I have also a phial that contains a number of pupæ extracted from worker-cells, together with one extracted from a queen's cell, showing how greatly these parasites differ in size; then I have larvæ of wasps only partially devoured, together with undergrown larvæ of *Rhipiphorus*. To myself such evidence is conclusive; and it only remains necessary that I examine how far Mr. Murray's discoveries are reconcilable with the apparently proved habit of the parasitism of *Rhipiphorus* as discovered by Mr. Stone.

Mr. Murray informs us that Miss Ormerod observed some cells with two eggs in each (about four in a score had two eggs); in others a young larva at the bottom, and an egg not yet hatched adhering to the cell higher up. Mr. Murray in these cases regards one of the eggs as that of *Rhipiphorus*; this is exactly what I should conclude would be the case; the egg of the parasite, since it feeds upon the full-grown larva of the wasp, after the latter has spun the silken covering to the cell, would remain undeveloped until the wasp-larva was full-

grown, and therefore not previously in a suitable condition for the larva of the parasite to feed upon.

The larva of *Rhipiphorus*, attached to that of the wasp which I possess, is about one-third of the size of the larva of its victim. In three instances Mr. Murray found a pupa of the wasp and also that of *Rhipiphorus* in the same cell, which is considered conclusive against the idea of one feeding upon the other; and it is assumed that they must have been hatched in the same cell, bred lovingly together, and have undergone their metamorphoses in the same cell.

I confess to the difficulty of satisfactorily accounting for this; but it is a well-known fact that parasites do, in some instances, feed upon the larvæ of insects without destroying them; this is of course in cases where the nourishment required by the parasitic larva does not injure or destroy the vitality of the larva preyed upon. *Stylops* is an instance of this kind; and I have bred a species of *Tachina* and a perfect example of *Saperda populnea* from the same cell. Other instances of the kind might be readily adduced; and it may be possible that in the instances mentioned by Mr. Murray the larva of *Rhipiphorus* did not consume the whole of the wasp-larva, did not, indeed, destroy its vitality: these pupæ are described as being stunted; and such may be the explanation. Be this as it may, from some cause or other, parasites (I do not assert that all do so, but many species) vary in size most astonishingly. No better instance of this can be mentioned than that of the common ruby-tailed fly, *Chrysis ignita*: this parasite I have myself reared from cells of *Odynerus parietum* and *O. antilope*; I have also bred them from the nest of *Vespa vulgaris*; and I have bred them from the cells of *Osmia bicornis*. *Osmia parietina* has also a species of *Chrysis* parasitic upon it; I bred it myself. Now, unless we conclude that *Chrysis* is a general feeder, that at one time it is nourished upon lepidopterous larvæ stored up by *Odynerus*, then that it is fed by the social wasp *V. rufa*, and lastly that it feeds in the nests of *Osmia* upon pollen and honey, we must consider it to be a carnivorous parasite, and that it feeds upon the larvæ of the insects whose nests it infests.

Now, I repeat, I know of no parasite that differs more in size than *Chrysis*; and this must, I think, be attributable to variation in the amount of sustenance they obtain: this would certainly be very great in the instances I have enumerated of the larvæ of *Vespa*, *Odynerus*, and *Osmia*. I possess examples of *C. ignita* varying in length from 3¾ to 7 lines. I may also instance, as examples of parasites that differ greatly in size, the genera *Sitaris*, *Meloë*, and *Rhipiphorus*.

In one instance the larva of a wasp was found by Mr. Murray in a cell together with one of *Rhipiphorus*, both being stunted in growth; in this case I am led to believe that both died before the parasite was full-fed, the stunted state of the wasp-grub being just what would naturally result from such a catastrophe. The nest of the wasp was removed from its situation, and both perished in consequence; the two larvæ were found head to head, that of the wasp squeezed out of shape, the result, I imagine, of the dying struggles of the parasitic larva.

In cells in which *Rhipiphori* were reared, the débris of the skin of a wasp-larva was found, which Mr. Murray regards as the cast skin of the larva, such, in fact, as is occasionally found in the cells both of the wasp and hornet; but I am inclined to regard these skins as those of the larvæ upon which the *Rhipiphori* had been nourished, and from which they had extracted the entire contents.

The cells which contain *Rhipiphorus* will always be found lined and capped like those of the wasp, because, as Mr. Stone has shown, the larva of the parasite does not commence its attack until the wasp-larva is full-grown and has spun itself up. I have repeatedly watched the larvæ of wasps in the act of spinning these convex caps to the cells; and until the same is observed of the parasite, I cannot but doubt the possibility of the latter doing so.

The following observation in Mr. Murray's paper must, I think, be an inadvertency:—"I here assume, as I think is the general belief, that this lining and lid are spun by the pupæ." I scarcely think it possible that any one can have expressed such an opinion; I at least am not aware of a single instance, and conclude that for pupæ we should read larvæ.

There are other portions of the paper which I leave untouched; some because I am not able to suggest any satisfactory elucidation, and others that do not come within the scope of the object I have in view, that of endeavouring to account for some of the circumstances observed by Mr. Murray, and also of stating that five years ago Mr. Stone convinced me of the true parasitism of *Rhipiphorus*, and I have not since acquired any information that induces me to change my opinion.

The following extract from the Papers of the Ashmolean Society strongly supports Mr. Stone's account of the parasitism of *Rhipiphorus*. After an observation to the effect that no one had hitherto observed any parasite attacking the ant, wasp, humble-bee, or hive-bee, the Rev. E. Bigge, the author of the paper from which the extract is made, observes, "As regards the wasp, however, it seems that this exemption does

not exist; for though I myself have not been so fortunate as to find any specimens of ichneumon in their nests, one has been seen in them by Mr. Denison in several instances, and observed in all the stages of its growth. It is described by him as a fly, as large, or nearly as large, as the wasp itself; the head and fore part of the body black, the abdomen yellow, with a dark streak down the back; legs and wings black; upper wings dusky. This fly (*Rhipiphorus*) deposits its egg upon the grub of the wasp at the moment it assumes the pupa (*i. e.* spins or covers itself in the cell); as soon as the egg is hatched, it devours the grub of the wasp entirely, and itself assumes the pupa- and imago-form in the cell of the wasp."

XLVII.—*On certain nondescript Bones in the Skull of Osseous Fishes.* By George Gulliver, F.R.S.

After the much ado of late years about the osteology of the fish's head, it may seem surprising to announce undescribed cranial bones or ossicles in these animals. But that there are such pieces of the skull will probably be admitted by anatomists who may pay attention to the question.

A relation of the means by which these bones became known to me will show how and where they may be found; and this is the object of the present communication.

In separating and trying to put together again that segment of the fish's skull known as the frontal vertebra or prosencephalic arch, I have always found supernumerary bones—that is to say, besides all those usually given as composing that arch, a pair of neat ossicles, each of them thin, cup-shaped and subconical, somewhat triangular or subpyramidal, and measuring, in large codfish, about three-fourths of an inch across the base of the cone and in depth. The apex of each of the bones is rather obtusely pointed; and either of them, with its small end most deeply placed, occurs regularly, sunk into a pit, and easily separable therefrom in the boiled fish's head, at the hind part of each postfrontal.

The woodcut represents, of the natural size, one of these postfrontal ossicles, or *expostfrontals*, from a small codfish.

After a diligent search through the English books of comparative anatomy, I have been unable to discover any notice of the bones in question. And as they had so often puzzled me, I took them to London, on the 6th of August last, when and where they were compared with the admirable preparations of the skele-

tons of fishes in the Museum of the Royal College of Surgeons; but the search for any display or representation of the new bones in that great collection proved equally fruitless.

On the 4th of November succeeding, Mr. James Flower, the eminent articulator, kindly showed me dissections which, in consequence of my having submitted the new bones to his examination on the 4th of August preceding, he had recently made of the skull of the codfish. And I was gratified to learn that he had thus not only confirmed my discovery but added to it the discovery of other and similar bones. They are all of the squamous kind, and shaped something like small and deep limpet-shells, and occur, as before said, connected with the postfrontals and also with the squamosals or mastoids and the epiotics or paroccipitals; so that, on each side of the head, there is a short chain of the new bones sloping backwards from the postfrontal to the epiotic.

Provisionally, the postfrontal ossicles, one of which is now figured, may be called, from their situation and for convenience, *expostfrontals*.

A correct understanding of "the bones which enter into the composition of the skull of the fish" is said to be "the key to the composition of the skull of all Vertebrata." But now it seems that all these bones or pieces in fishes have not hitherto been recognized, much less understood; while it is obvious that, until every part of their skull has been estimated at its true value separately, as well as with its connexions in the species and homologies as regards other Vertebrata, no complete view can be given of this important part of osteo-

And, no doubt, now the profound practical knowledge of Mr. James Flower, to whom this science is so much indebted, has been directed to the facts, they will be so displayed in our national museum of anatomy as to afford, under the care of the excellent professor and conservator, every facility for further investigations.

Canterbury, Nov. 9, 1869.

XLVIII.—*Description of a new Species of* Epeïra. By John Blackwall, F.L.S.

Epeïra Mengii.

Length of the female $\frac{5}{24}$ of an inch; length of the cephalothorax $\frac{1}{10}$, breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{8}$; length of an anterior leg $\frac{3}{16}$; length of a leg of the third pair $\frac{1}{6}$.

The cephalothorax is convex, glossy, compressed before,

truncated in front, rounded on the sides, and has a large indentation in the medial line of the posterior region; it is of a pale yellowish-brown colour, with a somewhat obscure soot-coloured band, which is bifid before, extending from the medial indentation nearly to the eyes, and a short streak of the same hue directed backwards from each lateral pair of eyes. The falces are powerful, conical, convex near the base in front, somewhat inclined towards the sternum, armed with teeth on the inner surface, and of a brownish-yellow hue, the anterior convexity being rather the darkest. The maxillæ are straight and increase in breadth from the base to the extremity, which is rounded; they are of a dull reddish-brown colour, being darkest in the medial line. The lip is semicircular; and the sternum is heart-shaped, with prominences on the sides, opposite to the legs. These parts are of a dark reddish-brown hue, the base of the former and the lateral margins of the latter being much the darkest. The legs are long, slender, provided with hairs and erect black spines, and of a yellowish-brown colour, the tibiæ and metatarsi of the third and fourth pairs having a few obscure brownish annuli; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws of the usual structure, and below them there are several smaller ones. The palpi resemble the legs in colour, but they are without annuli, and have a slightly curved, minutely pectinated claw at their extremity. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones nearly form a square, the two posterior ones being rather wider apart than the anterior ones, which are seated on a slight prominence; and those of each lateral pair are placed obliquely on a tubercle, and are near to each other, but not in contact. The abdomen is oviform, sparingly clothed with short hairs, convex above, and projects over the base of the cephalothorax; at its junction with the latter part a semicircular brown mark occurs whose convexity is directed upwards; on the upper part there is a large, olive-brown, leaf-like mark, minutely freckled with pale-yellow, and more or less tinged with red, on the posterior half of whose sinuous margins there are several black spots; the anterior part of this leaf-like mark is the broadest, and comprises a large irregular white mark, to which succeed several somewhat triangular ones that diminish in size as they approach the spinners; the entire series is bisected longitudinally by a fine ramified black or brown line; on each side of the leaf-like mark there is a broad, irregular, white band, sometimes having a tinge of pale red; the sides have a dark-brown hue mottled with pale yellow, and the under part, which

is of a yellowish colour reticulated with brown, has a broad, dark-brown longitudinal band in the middle, bounded on each side by a yellowish-white line; two yellowish-white spots occur on each side of the spinners; and the branchial opercula have a brownish-yellow hue, that of the sexual organs, which are moderately developed and glossy, being reddish-brown.

The male is smaller and darker-coloured than the female; but its legs are longer, an anterior one measuring $\frac{13}{24}$ of an inch, and those of the third and fourth pairs are commonly without dark annuli. There is a general resemblance in the design formed by the distribution of the colours on the upper part of the abdomen of both sexes, but it is not so well defined in the male as in the female. The cubital and radial joints of the palpi are short, the latter, which is the longer, having a very minute apophysis at its extremity in front; the digital joint consists of three parts: one, which is straight and glossy, with a minute process on its outer side, projects in front; another, united to the base of the former on its outer side, is slender and hairy; and the third, which is much the largest, is somewhat oval, greatly contracted at the base, convex and hairy externally, and concave within; all are connected with the palpal organs, which are moderately developed, not very complex in structure, with a strong piece curved obliquely from the upperside to their extremity, and are of a dark red-brown colour. The convex sides of the oval parts of the digital joints are directed towards each other.

This spider, which varies greatly in colour, is of frequent occurrence in Denbighshire, constructing its symmetrical snare in the intervals between the slender branches of low bushes, especially of such as grow in woods. In its structure, habits, and economy it bears a very close resemblance to *Epeïra inclinata*, but it is smaller and lighter-coloured than that species, and constantly begins to pair early in June, about three months sooner than its nearly allied congener.

M. Menge, in his 'Preussische Spinnen,' p. 88, pl. 14. tab. 24, has noticed several minute particulars in which the spider above described appears to differ from *Epeïra inclinata* (*Meta segmentata*, Menge), but does not consider them of sufficient importance to constitute a species. The interesting fact already alluded to, of which M. Menge probably may not be cognizant, namely, that the times at which these spiders respectively arrive at a state of maturity are separated by a period of rather more than three months, I regard as such conclusive evidence of their specific distinctness that I do not hesitate to confer on this *Epeïra* the name of the distinguished Prussian arachnologist.

XLIX.—*On the Coleoptera of St. Helena.* By T. Vernon Wollaston, M.A., F.L.S.

[Continued from p. 321.]

Fam. 18. **Curculionidæ.**

(Subfam. Cossonides.)

Genus 27. Stenoscelis.

Wollaston, Journ. of Ent. i. 141 (1861).

34. *Stenoscelis hylastoides.*

S. subcylindrica, nigra vel nigro-picea, fere calva, subnitida; capite prothoraceque sat profundo et confertissime punctatis, illo convexo æquali, hoc subæquali postice recto truncato immarginato, pone medium ad latera subrecto sed ibidem paulo sinuato; elytris piceis, striato-punctatis ac rugose seriatim asperatis, asperitate antice plicaturas transversas sed postice tubercula parva acuta efformante, interstitiis minutissime punctulatis; antennis pedibusque piceis, illarum capitulo horumque tarsis pallidioribus.

Long. corp. lin. $1\frac{1}{2}$-2.

Stenoscelis hylastoides, Woll., *loc. cit.* 142, pl. 11. f. 1 (1861).

The examples which I originally described of this curious insect, and for the reception of which I found it necessary to establish a new genus, were taken by the late Mr. Bewicke, in 1860, at the Cape of Good Hope; and it is an interesting fact, therefore, geographically, that (judging from an extensive series which was captured by Mr. Melliss) the species would appear to be common also at St. Helena. After giving, in the 'Journal of Entomology,' a lengthened diagnosis of the group, I added:—"So very closely does the present insect, at first sight, assimilate *Hylastes*, that I had regarded it, previous to a critical examination, as an abnormal member of that group, in which the external edge of the tibiæ was edentate. But, on closer inquiry, it proves to be undoubtedly one of the *Curculionidæ*, the entire structure of its slender, toothless, *apically uncinate* tibiæ, and its unreceived tarsi, assigning it to that family. From *Rhyncolus*, however, to which it is clearly related, it recedes completely in its excessively short, broad, thick, and subtriangular rostrum, in its very abbreviated and differently constructed antennæ (which have apparently no lateral *scrobs* for the reception of their scape), in its minute, punctiform scutellum, its more globose, exposed head, and in its longer feet; and I should consider that the Madeiran *Hexarthrum* is perhaps its nearest described ally,—though in that genus the funiculus is only 6-articulate, whereas in *Stenoscelis* it is 7-."

Genus 28. Microxylobius.

Chevrolat, Trans. Ent. Soc. Lond. i. 98 (1836).

The excessive importance at St. Helena (where it is manifestly aboriginal, and to which it seems to be peculiar) of the little Curculionideous genus *Microxylobius* induces me to enter more fully into its details, in this memoir, than I should otherwise have thought it necessary to do; and therefore, in addition to the four new species enunciated below, I have given emended diagnoses of the five which were first captured by the late Mr. Bewicke in 1860, and published by myself during the following year, in the 'Transactions of the Entomological Society of London.' By this method I am enabled to form a monograph of the genus, as known up to the present date,—the *M. Westwoodii*, for the reception of which the group was originally proposed by M. Chevrolat in 1834, being the only representative of which I have not been able to obtain a sight, and concerning the exact *specific* features of which I am consequently ignorant. Indeed it is much to be regretted that Chevrolat's description, both of the genus and species, is not more minute; for had it not been for Professor Westwood's admirable figure, it would have been next to impossible to gain any definite idea from either the one or the other.

As regards the structure and affinities of *Microxylobius*, the few following remarks, which I appended to my generic diagnosis in 1861, will not be considered out of place:—"After a careful consideration of the five insects described below, all of which were taken at St. Helena by Mr. Bewicke (amongst native vegetation on the extreme summit of the island), I have come to the conclusion, in spite of their great variety of outline and the anomalous character possessed by two of them *of a large acute spine towards the base of the upper* (!) *edge of their femora*, that they are nevertheless members of a single group; and I am the more convinced of this, since in many well-known Rhynchophorous genera (such as *Ceuthorhynchus* and *Cœliodes*) we have exponents with toothed thighs (though toothed in the usual manner, it is true—*i. e.* on the *under* side, not on the upper), and others with simple ones. For when we take into account their peculiar feature of a five-jointed funiculus, as well as their more or less glabrous *

* Although true in the majority of the species, the character "corpore glabro" will not rigidly apply, I now find, to the entire genus; for in the *M. vestitus* (which may *possibly* prove to be conspecific with the *M. Westwoodii* of Chevrolat) the body is sparingly sericeous, whilst even in the *M. lacertosus* there are indications of very short and minute hairs arranged down the interstices of the elytra.

bodies, their obsolete scutella, and the other essential points of their structure, it is impossible to help perceiving that they are all nearly akin *inter se*, and cannot properly be separated. I have, however, formed a distinct section for the dentate species, and have given to it a provisional name, in the event of its being found desirable hereafter to detach it from the other."

"Although members of the same subfamily, and possessing a five-jointed funiculus, the *Microxylobii* are essentially distinct from the *Pentarthra*, and may be regarded as a little geographical assemblage, in all probability (like the *Caulotrupides* in Madeira), peculiar to St. Helena. Apart from their very great difference of outward configuration, and the spiniferous femora of some of them, they may be known from the *Pentarthra* (which are narrow, cylindrical, linear, deeply sculptured insects, on the *Mesites* and *Cossonus* type) by their obsolete scutellum and more elongated limbs and rostrum—the latter of which is, moreover, less straightened, and has the antennæ inserted much nearer to its apex; whilst the antennæ of the *Pentarthra* are, in both sexes, *medial*, or (if anything, perhaps) implanted a trifle even *behind** the middle rather than before it."

§ I. *Femora mutica.* (Microxylobii *typici.*)

A. *Funiculi art^us 1^mus secundo distincte latior; 2^dus tertio vix longior.*

35. *Microxylobius Westwoodii.*

M. "nigro-æneus, glaber; capite rostroque punctulatis, thorace constricto infra apicem, elytris subrugatis, corpore subtus punctatissimo. Long. corp. lin. circiter 1, lat. ½ lin.—Ex museo *Dom. Saunders. Habitat* ins. St. Helena." [Ex *Chevrolat.*]

Microxylobius Westwoodii, Chevr., Trans. Ent. Soc. Lond. i. 98, pl. 10. f. 6 (1836).
—— ——, Woll., *ibid.* v. (n. s.) 381 (1861).

This species being the one for which the genus was originally founded by M. Chevrolat, I have no choice but to regard it as the type of the group; and it is therefore extremely unfortunate that I should have been unable to obtain a glance at the individual from which Prof. Westwood's excellent figure which accompanied the diagnosis was drawn. Judging from the plate *alone*, I should have been contented to cite the following species (which I describe under the trivial name of *vestitus*) as the true *M. Westwoodii*, had not Chevrolat distinctly stated his insect to be *glabrous*, and not only to have its elytra less parallel (or more expanded behind the middle) and with the base

* This, however, is hardly the case in the St.-Helena *P. subcæcum.*

and suture raised, but its tibiæ likewise (as I believe) to be more curved and robust. Still it is not impossible that Chrevrolat's example may have been an old and worn one, from which the rather sparing and delicate pubescence had been rubbed off, in which case there is at least an additional *chance* that it may prove eventually to be identical with my *M. vestitus*; but, as the group is evidently rich in species, I am inclined to suspect that the "raised suture" and other minute characters (as recorded) will tend to separate the *M. Westwoodii* from its manifestly near ally.

36. *Microxylobius vestitus*, n. sp.

M. elongatus, angusto-fusiformis, æneo-piceus, subopacus, pilisque brevibus sericeis demissis fulvo-cinereis parce vestitus; capite rostroque alutaceis, minute et leviter punctulatis, hoc breviusculo sed subgracili-lineari et supra subgibboso; prothorace subovato, pone medium rotundato, alutaceo et punctulis levibus parce irrorato; elytris confuse rugulosis (vix punctatis, vix tuberculatis, et vix striatis); antennis pedibusque piceo-testaceis.

Long. corp. lin. $1\frac{1}{4}$.

Judging from the short diagnosis of the *M. Westwoodii*, that species, the present one, and the following are, from their smaller size and (I believe) less glabrous surfaces, more nearly related *inter se* than they are with the other members (hitherto detected) of this curious little group. As already implied, the description published by M. Chevrolat of the *M. Westwoodii*, if not positively inaccurate, is so manifestly insufficient to distinguish it from the allied representatives of a genus like *Microxylobius* that I should not feel altogether surprised if the particular species now under consideration (and to which I have given the name of *vestitus*) should prove eventually to be identical with the *M. Westwoodii*; for if the example described by Chevrolat happened to be an old and worn one, from which the rather delicate and sparing sericeous pubescence had been accidentally rubbed off, the main and most important feature in a small assemblage the exponents of which are principally *altogether bald* may have been overlooked, and the species enunciated as "glabrous." Of course, however, I cannot venture to *act* on such an assumption, and I have therefore treated the present *Microxylobius* (from a single specimen now before me, which has been communicated by Mr. Melliss) as new. Its narrowish, elongate-fusiform outline and somewhat sparingly and minutely sericeous brassy-brown surface, added to its alutaceous head and prothorax (on the latter of which the small and lightly impressed punctules are rather remote), its somewhat narrow and parallel but not very elongate rostrum (which is a trifle gibbous above the implanta-

tion of the antennæ), its confusedly rugulose elytra and *comparatively* pale limbs, will sufficiently distinguish it.

37. *Microxylobius lacertosus.*

M. elongato-ovatus (elytris pone medium sublatioribus), niger (immaturus piceseens, sed nullo modo metallicus), opacus, alutaceus; capite rostroque confertissime punctatis, hoc crasso, subtriangulari, convexo; prothorace amplo, longiusculo, ad latera minus rotundato, subconvexo, ubique grosso confertissime et (præsertim versus latera) rugose punctato; elytris subseriatim tuberculatis (nec punctatis), interstitiis leviter costato-elevatis setulisque minutissimis cinereis (interdum vix observandis) uniseriatim obsitis; antennis pedibusque (præsertim posticis) breviusculis, crassiusculis, rufo-piceis.

Long. corp. lin. $1\frac{1}{4}$–$1\frac{1}{2}$.

Microxylobius lacertosus, Woll., Trans. Ent. Soc. Lond. v. 381, pl. 18. f. 5 (1861).

Several examples of this little *Microxylobius* are amongst Mr. Melliss's Coleoptera; and as it was also found by the late Mr. Bewicke during his few hours' visit to the summit of the island in 1860, there is sufficient reason to conclude that it is not uncommon in the higher districts at St. Helena. In size it appears to be scarcely larger than the *vestitus* and *Westwoodii*; but it is altogether more robust and deeply sculptured, blacker and more opaque; its rostrum is thicker and more triangular, its punctation is much more *dense* (as well as coarser), its limbs are stronger and more incrassated, its outline is a little more ovate or rounded outwards *behind* the middle of the elytra, and the latter are confusedly roughened with small indistinct tubercles placed in longitudinal rows, the interstices between which are slightly elevated and studded (in unrubbed specimens) with a row of excessively short and infinitesimal cinereous hairs, which, however, without a powerful glass are barely visible. Although rather difficult of observation, I lay considerable stress upon this last-mentioned character, because, *with the exception of the M. vestitus*, I have no evidence (even whilst *suspecting* that it may be found to exist in Chevrolat's *M. Westwoodii*) that there are even traces of *pubescence* on the other members of the group.

38. *Microxylobius lucifugus.*

M. fusiformis, crassus, niger (immaturus picescens), subnitidus, calvus, punctatissimus; capite rostroque confertim et profunde punctatis, hoc crasso et (præsertim in masculis) subtriangulari, ad apicem in medio leviter depresso; prothorace amplo, longiusculo, ad latera rotundato, convexo, confertim profunde et argute punctato; elytris (rarius obsoletissime subæneseentibus) subcon-

vexis, rugulosis, leviter et late punctato-substriatis, interstitiis latis, confertim et profunde punctatis (punctis interdum quasi in serie duplici aut triplici obsoletissime dispositis); antennis crassiusculis, rufo-piceis, basi clarioribus; pedibus crassis, piceis.

Variat elytrorum striis plus minus obsoletis.

Long. corp. lin. 2–2½.

Microxylobius lucifugus, Woll., Trans. Ent. Soc. Lond. v. 382, pl. 18. f. 6 (1861).

There are several examples of this large and well-marked *Microxylobius* amongst the *collectanea* of Mr. Melliss; and as it was likewise captured by Mr. Bewicke, in 1860, during the few hours which he passed in the higher districts of St. Helena, we may expect it to be tolerably common in the more elevated regions of that island. It is easily recognized by its large size, robust body, blackened hue, and thick limbs, by its densely and deeply punctured, though but slightly shining, surface (which, however, is less opaque than in the *lacertosus* and *vestitus*), by its thickened rostrum (particularly in the male sex), by its ample, laterally rounded prothorax, and by its rugulose elytra. Like the remainder of the *Microxylobii* enumerated below, its surface is free from all traces of even minute pubescence.

B. *Funiculi art^us 1^mus secundo vix latior; 2^dus tertio multo longior.*

39. *Microxylobius terebrans.*

M. subovato-fusiformis, æneus, nitidus, calvus; capite rostroque confertim punctatis, hoc longiusculo, subtereti; prothorace subovato, basi truncato, ad latera rotundato, convexo, confertim et sat profunde punctato; elytris convexis, ad latera parum rotundatis, leviter et late punctato-striatis (striis ad basin ipsam profundioribus), interstitiis latis, sat confertim et profunde punctatis (punctis interdum quasi in serie duplici vel triplici obsoletissime dispositis); antennis rufo-piceis, basi clarioribus; pedibus nigropiceis, tarsis rufo-piceis.

Long. corp. lin. vix 2.

Microxylobius terebrans, Woll., Trans. Ent. Soc. Lond. v. 383, pl. 18. f. 7 (1861).

It is somewhat singular that the present species is not represented amongst the numerous specimens of *Microxylobius* which have been captured by Mr. Melliss; so that my diagnosis has simply been drawn out, and corrected, from the original pair which were captured by the late Mr. Bewicke at St. Helena in 1860. In its brassy hue and shining surface it recedes from the preceding members of the group, and assimilates those which follow; but the fact of its tibiæ being simple will at once separate it from the whole of the latter except the

M. obliteratus and *debilis*. Apart, however, from its different outline, and perhaps rather less intensely brassy tinge, it may be known from both of these by its larger size and by being altogether more coarsely and closely punctured. Its elytral striæ, moreover, are deeper at their extreme base, and have the appearance at first sight of short divergent grooves.

40. *Microxylobius obliteratus*, n. sp.

M. breviter ovato-fusiformis, læte æneus, nitidissimus, calvus; capite parce et leviter punctulato, rostro (saltem in fœminis) elongato subgracili tereti, in maribus sat profunde sed in fœminis minutius punctato; prothorace ovato, basi truncato, ad latera parum rotundato, convexo, parcius et plus minus obsolete punctato (punctis magnis sed levibus, interdum subobliteratis); elytris convexis, ad latera rotundatis, leviter punctato-striatis, interstitiis leviter subseriatim punctatis (punctis ubique sat magnis sed levibus); antennis pedibusque fere ut in specie præcedente, sed illis paulo gracilioribus capitulo minus abrupto.

Long. corp. lin. $1\frac{2}{3}$.

The *M. obliteratus* is not only more highly polished and more resplendently brassy than the *terebrans*, but it is also a little shorter and relatively more ovate or elliptic, being wider in proportion to its length. Its rostrum and antennæ (which have their club less abrupt) are more slender, the former, in the female sex, being especially longer and more shining; and its prothorax and elytra, particularly the former, have their punctures (although perhaps equally large) altogether less densely packed and more lightly impressed—those on the prothorax indeed being sometimes, as in the case of a female example (the only one of that sex which I have yet seen) which is now before me, nearly obliterated. The very few specimens of this distinct *Microxylobius* which have come beneath my notice are amongst the Coleoptera captured by Mr. Melliss.

41. *Microxylobius debilis*, n. sp.

M. angustus, fusiformis, læte æneus, nitidus, calvus; capite parce et leviter punctato, rostro elongato subgracili sat confertim ac profunde punctato, prothorace ovali, convexo, parum grosse sed vix profunde punctato; elytris ellipticis (antice valde et gradatim angustatis—quare antice et postice subæqualiter attenuatis), grosse sed vix profunde striato-punctatis, interstitiis sat grosse uniseriatim punctatis, ad basin ipsissimam mucronibus asperatis; antennis pedibusque fere ut in specie præcedente sed subgracilioribus ac sensim obscurioribus, illis paulo brevioribus, funiculi art° 1mo secundo subbreviore (nec sublongiore).

Long. corp. lin. $1\frac{3}{4}$.

The single example from which the above diagnosis has

been compiled, and which was taken in St. Helena by Mr. Melliss, has such a curious outline, as compared with the other members of the genus hitherto known, that, before examination, I thought it just possible that it would prove to be but an ill-developed individual of one of the cognate brassy forms; but a more accurate inspection convinces me that it is thoroughly distinct and well-defined. Its comparatively narrow outline, indeed, when contrasted with the remainder of the æneous species, and greatly attenuated *anterior* portion of its elytra (causing the latter to be almost *equally* narrowed before and behind), added to its ovate prothorax, give it an appearance unlike that of any of its allies: and, amongst less conspicuous features, the minute asperities or points which stud the extreme base of its elytra (particularly towards the shoulders) should be likewise noticed. Its punctation is more distinct than in the *M. obliteratus*, and its elytral striæ are placed closer together, leaving the interstices narrower, and branded apparently with only a single row down each of large rounded punctures: its limbs, also, are a trifle slenderer and darker, with the antennæ (the first joint of the funiculus of which is, if anything, perhaps somewhat *shorter* than the second) appreciably less elongate.

§ II. *Femora postica spina magna acutissima subbasali supra armata.* (Microxylobii *aberrantes.* Subg. THAUMASTOMERUS, *Woll.*)

A. *Funiculi art^us^ 1^mus^ secundo vix latior; 2^dus^ tertio multo longior.*

42. *Microxylobius Chevrolatii.*

M. elongatus, oblongo-fusiformis, æneus sed interdum etiam subnigrescens, nitidus, calvus; capite rostroque sat confertim et argute punctulatis, hoc longiusculo, subtereti, apice obsolete depresso; prothorace subovato, basi truncato, ad latera rotundato, confertim sed minute ac levissime punctulato; elytris oblongis, leviter et late striato-punctatis; interstitiis latis et leviter punctatis (punctis quasi in serie triplici obsoletissime dispositis); antennis rufo-piceis, longiusculis, funiculi art° 2^do^ primo sublongiore; pedibus elongatis, nigro-piceis, tarsis rufo-piceis.

Long. corp. lin. 2½–vix 3.

Microxylobius Chevrolatii, Woll., Trans. Ent. Soc. Lond. v. 388, pl. 18. f. 8 (1861).

This is the largest of the *Microxylobii* hitherto detected, and it may be known (amongst the other brassy forms) by its elongate, somewhat oblong outline, and *very* finely and lightly punctulated prothorax. Its legs, feet, and the second joint of its funiculus are a good deal lengthened; and, as in the two

following species, the outer edge of its hinder femora is armed near to the base with an acute upwardly directed spine. Two examples of it were taken at St. Helena, in 1860, by the late Mr. Bewicke; and a third (of a slightly obscurer tinge) is now before me, from the collection of Mr. Melliss. Perhaps, therefore, it is one of the rarer species.

43. *Microxylobius conicollis.*

M. breviter elliptico-ovatus, æneus, nitidissimus, calvus, supra convexo-arcuatus; capite parce et leviter punctulato, rostro breviusculo subtereti valde deflexo sat profundius densiusque punctato; prothorace conico (i. e. postico lato necnon ad latera oblique recto), parce et levissime punctato (punctis sat magnis sed leviter impressis, interdum quasi subobsoletis); elytris sat profunde subpunctato-striatis, interstitiis latis et leviter subobliterato punctatis; antennis rufo-piceis, longiusculis, subgracilibus, funiculi art[is] subconicis, tamen inter se magis compactis, capitulo minus abrupto; pedibus piceis, spina femorali maxima.

Long. corp. lin. $1\frac{1}{2}$–$1\frac{5}{8}$.

Microxylobius conicollis, Woll., Trans. Ent. Soc. Lond. v. 384, pl. 18. f. 9 (1861).

The shortly ovate thickened body and convex *arcuate* upper surface of this highly polished, lightly punctured insect (its prothorax being not only conical, *i. e.* broadest at the extreme base and with the sides obliquely straight, but also *in a continuous curve* with the elytra), give it an appearance so totally distinct from the other species, that one might almost imagine it to constitute the type of some cognate but separate group; and indeed its rather differently constructed funiculus, the joints of which are more conical and more closely applied together than is the case in the generality of the *Microxylobii*, in conjunction with its more deflexed rostrum, might still further tend to the same conclusion. An accurate inspection, however, convinces me that it cannot be removed generically from the remainder of the brassy species, its singularity of contour being rather suggestive, to my mind, of specific links (more or less intermediate between the extremes of form) *yet to be discovered* than of any absolute *hiatus* such as its supposed generic isolation from the true *Microxylobii* would seem to imply: and I may add that the detection by almost every observer, at St. Helena, of undescribed species in a group thus extraordinary is quite in accordance with that hypothesis. In its most essential generic characters it is strictly a *Microxylobius*, its femoral spine (so enormously developed) and brassy hue removing it into that section of the genus to which (in case that it should be desirable to detach it hereafter from the other) I have given the provisional name of *Thaumastomerus.*

The *M. conicollis* was taken by the late Mr. Bewicke in 1860, and subsequently in profusion by Mr. Melliss, who informs me that it has attached itself mainly to the rotten branches of the oak trees which have been planted at a rather high elevation, and *beneath* which also (amongst the dead leaves) he has at times found it abundantly.

B. *Funiculus submoniliformis, articulis omnibus inter se subæqualibus.*

44. *Microxylobius monilicornis*, n. sp.

M. oblongo-fusiformis, æneus, nitidus, calvus; capite parce sed argute punctato, rostro breviusculo subtereti latiusculo confertim ac profunde rugoso-punctato; prothorace subovato, basi truncato, ad latera rotundato, convexo, dense argute et sat profunde punctato; elytris suboblongis, late et leviter striato-punctatis, interstitiis latis et dense arguteque punctatis (punctis vix subseriatim dispositis); antennis pedibusque piceis, illis ad basin tarsisque rufescentioribus.

Long. corp. lin. circa $1\frac{2}{3}$.

Judging from the many examples now before me, and which were captured by Mr. Melliss, this might perhaps be assumed to be one of the commoner of the *Microxylobii*; yet, on the other hand, it is a species which was *not* met with by the late Mr. Bewicke. It differs from the whole of the preceding ones in the comparatively moniliform structure of its funiculus, the five joints of which are *almost* of equal length and breadth—even the basal one being very little larger than the second. Its brassy hue and femoral spine indicate its affinity with the *Chevrolatii* and *conicollis*; but it is *much* more thickly and strongly punctured than either of them, its sculpture, size, and outline being rather more suggestive, at first sight, of the (unarmed) *M. terebrans* in the last section.

Genus 29. PENTARTHRUM.

Wollaston, Ann. Nat. Hist. xiv. 129 (1854).

45. *Pentarthrum subcæcum*, n. sp.

P. angusto-cylindricum, piceum, nitidum, calvum; rostro breviusculo, crassiusculo, subtereti, convexo, basi latiusculo, minute et leviter punctulato, oculis obsoletissimis, obliteratis, punctiformibus [an vere observandis?], quasi nullis; prothorace elongato, subovato, basi truncato, ad latera rotundato, pone medium coleopteris evidenter latiore, argute (sed haud grosse) punctato; scutello haud observando; elytris angustis, parallelis, argute et laxe striato-punctatis (punctis sat magnis necnon inter se parum remotis), interstitiis latis et minutissime uniseriatim punctulatis; antennis pedibusque breviusculis, paulo rufescentioribus; funi-

culo 5-articulato, art° 1^mo^ fere obtriangulari, 2^do^ paulo minore et sequentibus (subæqualibus) vix longiore ; tarsis gracilibus, art° 3^tio^ minus dilatato, præcedentibus vix latiore, et vix bilobo.

Long. corp. lin. $1\frac{1}{3}$.

The unique example from which the above diagnosis has been drawn out, and which was captured at St. Helena by Mr. Melliss, possesses so unmistakable an affinity (in its five-jointed funiculus and the general contour of its narrow, subcylindrical, sculptured body) with the genus *Pentarthrum* (as known hitherto through the *P. Huttoni* from the west of England and the *P. cylindricum* which was found by Mr. Bewicke at Ascension) that I cannot persuade myself that it should be separated therefrom, even whilst equally aware that its obsolete eyes and scutellum would, of *themselves*, tend to affiliate it rather with the little group *Mesoxenus*, of the Madeiran and Canarian archipelagos. Yet I feel so satisfied that it has more in common with *Pentarthrum* than with *Mesoxenus* that I have preferred assigning it to the former, even should my doing so necessitate the diagnosis of that genus being so far widened as to embrace representatives in which (like the *Mesoxeni*) the eyes and scutellum are obsolete. Perhaps, in reality, however, it will be found desirable, in the end, to treat it as the type of a yet additional group—combining the external aspect of *Pentarthrum* with the escutellate sub-eyeless body of *Mesoxenus*; but as these little Cossonideous assemblages are already perhaps somewhat too numerous, I will not at present add another to their number, but will be content to cite the very interesting weevil now before me as an *aberrant Pentarthrum* in which there are no traces of a visible scutellum, and none also (beyond the merest rudimentary punctiform specks—of *the true existence* of which I can scarcely satisfy myself, even beneath the microscope) of eyes.

The *P. subcæcum* is darker and less deeply sculptured than either the *P. Huttoni* or the *cylindricum*, and it is, if anything, perhaps a trifle narrower and smaller than even the latter; but its prothorax is less strictly *conical* than in the Ascension species, assuming more the outline of the English *P. Huttoni*, in which the sides are more rounded, and the widest part is (not at the extreme base, but) a little behind the middle. In the structure and shortness of its limbs and rostrum it recedes from the *Mesoxeni*, and is in exact accordance with the true *Pentarthra*. In any case, its discovery at St. Helena is, in a geographical point of view, extremely interesting, the various Atlantic islands having already supplied so many anomalous additions (both in genera and species) to these immediate Cossonideous groups.

(Subfam. RHYNCHOPHORIDES.)

Genus 30. SITOPHILUS.

Schönherr, Gen. et Spec. Curc. iv. 967 (1838).

46. *Sitophilus oryzæ**.

Curculio oryzæ, Linn., Cont. Ins. 12 (1763).
Sitophilus oryzæ, Woll., Col. Atl. 265 (1865).
—— ——, Id., Col. Hesp. 125 (1867).

This almost cosmopolitan spotted Curculionid has apparently established itself at St. Helena (judging from examples collected by Mr. Melliss), just as it has in the Azorean, Madeiran, Canarian, and Cape-Verde archipelagos; but, being eminently liable to distribution, through the medium of commerce, over more or less of the civilized world, its presence is totally without significance in the fauna of any country.

(Subfam. SYNAPTONYCHIDES.)

Genus 31. NESIOTES.

Wollaston, Journ. of Ent. i. 211 (1861).

The two singular little Curculionids described below, for the reception of the former of which the present genus was established by myself in 1861, are so remarkable that I was totally unable to come to any satisfactory conclusion as to their precise affinities; but the invaluable and more recent work of Lacordaire has given a position to the group which certainly I had little anticipated, but which tallies well with the various details of its structure. He regards it as related to the European *Trachodes*, and still more so to *Echinosoma* of Madeira, in the latter of which the funiculus is likewise only 5-articulate; and he consequently erects these three genera, together with *Synaptonyx* from Australia, into a little subfamily (under the title of *Synaptonychides*) of his sixteenth tribe "*Tanyrhynchides.*" This arrangement brings it into juxtaposition with one of the most anomalous and endemic of the Madeiran weevils, the *Echinosoma porcellus*; and it supplies another instance of that curious analogy by which so many of the most extravagant forms of these widely scattered Atlantic islands are mysteriously bound together.

Speculating on the position of *Nesiotes* in a natural system, I wrote, in 1861, as follows:—"The remarkable little insect for which I have been compelled to erect the present genus has, at first sight, so much the appearance of a small *Acalles*, that (before critically overhauling it) I had placed it aside as a member of that group. On closer examination, however, its

funiculus is composed of only five joints (instead of seven), whilst there is no trace of a pectoral groove for the reception of its rostrum. It is consequently excluded from the whole subfamily *Cryptorhynchides* by this latter circumstance *alone*; whilst from the *Cossonides*, with some of the genera of which it would agree as regards the former, it is altogether remote." But now that its affinities have been satisfactorily cleared up by Lacordaire, I feel that no further comment on its structure is necessary.

I. *Funiculi art^us 2^dus primo sublongior.*

47. *Nesiotes squamosus.*

N. ovatus, nigro-piceus, opacus, alutaceus (nec punctatus, nec tuberculatus), squamis fulvo-cinereis crassis demissis plus minus vestitus; prothorace subconvexo, mox ante medium rotundato-ampliato, postice angustiore subrecto; elytris convexis, ventricosis, in medio facile rotundato-ampliatis et ibidem prothorace multo latioribus; antennis gracilibus, rufo-ferrugineis, basin versus clarioribus; pedibus crassis, squamosis, tarsis clarioribus.

Long. corp. lin. $1\frac{1}{2}$.

Nesiotes squamosus, Woll., *loc. cit.* 212, pl. 14. f. 3 (1861).

The only examples of this interesting little Curculionid which I have yet seen are two which were taken at St. Helena by the late Mr. Bewicke, during a few hours' collecting in that island, *en route* from the Cape of Good Hope to Madeira, in 1860. Apart from the greater length of its second funiculus-joint, it may at once be known from the following species by its much broader and more ovate or ventricose outline (the elytra about the middle being *very* much wider than the prothorax), and by its surface, when denuded of the decumbent fulvescent scales, being simply alutaceous throughout, having no appearance of either punctures or tubercles. If, also, my two specimens may be relied upon, it would seem to be free from the short erect *setæ* which (in addition to the coarse mud-like scales) stud the *N. asperatus*.

II. *Funiculi art^us 2^dus primo subbrevior.*

48. *Nesiotes asperatus*, n. sp.

N. ovato-oblongus, elongatus, angustulus, nigro-piceus, opacus, alutaceus necnon grosse granulato-asperatus, squamis fulvo-cinereis quasi lutosis setulisque brevibus erectis dense vestitus; prothorace subinæquali, (subter squamis) tuberculis crebre asperato, ad latera leviter rotundato; elytris angustulis, subovato-elongatis, pone medium facile vix rotundatis, (subter squamis) tuberculis in spa-

tiis longitudinalibus crebre asperatis; antennis gracilibus, rufo-ferrugineis; pedibus fere ut in specie præcedente, sed tarsorum art° 3tio paulo minus dilatato.

Long. corp. lin. 1¼–1¾.

It is somewhat remarkable that a large array of individuals now before me, collected at St. Helena by Mr. Melliss, should belong entirely to a new representative of the present group, quite distinct specifically from the little *Nesiotes* which was found by Mr. Bewicke, and that thus a second member has been added to one of the most interesting and truly indigenous of the island forms. The *primâ facie* aspect of the *N. asperatus* is still more suggestive, than even that of the *N. squamosus*, of a minute *Acalles*; but, as already pointed out, its total want of a pectoral groove separates it, independently of all other characters, from the whole department of the *Cryptorhynchides*. It is very much narrower and more oblong (in proportion to its size) than the *N. squamosus*, its elytra, even in their widest part (a little behind the middle), being scarcely if at all broader than the prothorax; and its surface is not only more densely covered with brown mud-like scales, and intermixed with short erect setæ (which I do not observe in my two examples of its ally), but likewise studded (as will be seen when the clothing is removed) with robust granuliform tubercles, which entirely cover the somewhat uneven prothorax, but which on the elytra are distributed in wide (more or less anteriorly confluent) longitudinal spaces. The second joint also of its funiculus is appreciably shorter than that of the *N. squamosus*, being, perhaps, if anything, more abbreviated than the basal one; and its body is coarsely and closely punctured beneath.

Both the present species and the preceding one are most unmistakably indigenous at St. Helena, being without doubt amongst the most characteristic of the aboriginal forms; and I believe that I was informed by Mr. Melliss that his examples of the *N. asperatus* were taken, for the most part, amongst and beneath fallen leaves at a rather high elevation.

(Subfam. Trachyphlœides.)

Genus 32. Trachyphlœosoma (nov. gen.).

Corpus parvum, breviter ovale, apterum, squamosum, hispidum, *Trachyphlœum* simulans; sed *rostro* breviore, subconico (nec parallelo), supra convexiusculo et ad apicem recte truncato (nec triangulariter emarginato), *antennis* fere sub angulos ipsos anticos insertis, *scrobe* multo magis infra *oculos* (minutissimos, demissos, remotiores) deflexa. *Antennæ* (funiculo 7-art°) fere ut in *Trachy-*

phlœo, sed paulo graciliores. *Tarsorum art*° 3^{tio} minus late bilobo; *unguiculis* submajoribus.

A *Trachyphlœus* (genus Curculionidum), et σῶμα, corpus.

The insignificant little brown Curculionid from which I have compiled the above structural diagnosis, and which is manifestly one of the most indigenous of the St.-Helena Coleoptera, has so much the *primâ facie* appearance, in its short oval outline and the mud-like scales and setæ with which it is clothed, of a minute *Trachyphlœus* that it required a close examination to convince me that it should not be referred to that group. When carefully inspected, however, it will be seen to have many essential points of difference; for not only is its rostrum more abbreviated and conical, and *truncate* (instead of triangularly scooped out) at the tip, but its scrobs is likewise more bent downwards (and that very suddenly) beneath the still smaller and less prominent eye, from which, consequently its lower edge is much more remote; its antennæ also are a trifle less incrassated, and inserted appreciably nearer to the apex of the rostrum; and its feet have their third joint less broadly bilobed, and their claws a little more developed. On the whole, I should say that it had more in common with my Madeiran genus *Scoliocerus* than with *Trachyphlœus* proper; nevertheless the position of its rostral grooves and its less curved scape will of themselves suffice to separate it therefrom.

49. *Trachyphlœosoma setosum*, n. sp.

T. breviter ovatum, squamis nigro-brunneis quasi lutosis densissime tectum setisque fulvo-cinereis suberectis parce obsitum, (subter squamis) piceum; prothorace subter squamis grossissimo punctato, punctis maximis, inter se subconfluentibus; elytris subter squamis valde profunde striato-punctatis, punctis magnis et argute determinatis.

Long. corp. lin. vix $1\frac{1}{4}$.

Many examples of this obscure little *Trachyphlœus*-like weevil, which were taken by Mr. Melliss at St. Helena, are now before me; and there can be little doubt, I think, that it is a truly aboriginal form. Its dull muddy-brown surface, which is thickly incrusted with scales and more sparingly beset with short suberect fulvo-cinereous setæ, will be seen, *when the covering is abraded or removed*, to be most coarsely, but widely sculptured,—the punctures on the prothorax being enormous, though rather irregular and subconfluent, whilst those which stud the elytral striæ are perhaps not quite so large, but deep and better defined.

(Subfam. OTIORHYNCHIDES.)

Genus 33. SCIOBIUS.

Schönherr, Curc. Disp. Meth. 197 (1826).

50. *Sciobius subnodosus*, n. sp.

S. ovatus, piceus, squamulis fulvo- (vel etiam obscurissime submetallico-) cinereis plus minus vestitus setulisque suberectis subcinereis in elytris seriatim obsitus; rostro breviter subcylindrico, apice triangulariter exciso, in medio argute carinato, scrobe profunda (margine inferiore decurva) ante oculos (valde prominentes) evanescente, fronte subito convexa; prothorace confuse subtuberculato-ruguloso, in disco leviter carinato et utrinque versus latera obsolete et late longitudinaliter impresso; scutello nullo; elytris ovalibus, prothorace latioribus, late punctato-sulcatis, interstitiis postice plus minus evidenter subnoduloso-elevatis; antennis gracilibus, funiculi (7-articulati, filiformis) art° 2^{do} elongato.

Long. corp. lin. circa 3.

Several specimens of an obscure brownish weevil now before me, and which were taken by Mr. Melliss at St. Helena, I have no doubt are referable to the Otiorhynchideous genus *Sciobius*, all the exponents of which, hitherto known, appear to be South-African; whilst its ovate body and slightly impressed prothorax (on either side) affiliate it with a small group of five species described by Boheman in the seventh volume of Schönherr's 'Genera et Species Curculionidum,' with the diagnosis of none of which, however, it would appear absolutely to agree. In all probability, it is a truly indigenous insect at St. Helena, and, though seldom more than about 3 lines in length, it is the largest of the *aboriginal* Curculionids described in this memoir (the *Otiorhynchus sulcatus* being manifestly introduced); and it may further be known by its brownish and rather coarsely sculptured surface being clothed with minute ashy or yellowish brown scales, and studded on the elytra with short suberect setæ placed in longitudinal rows, by its rostrum and prothorax being very delicately keeled down the centre, and by its elytral interstices being a good deal raised and interrupted posteriorly, so as to shape out a few more or less obscure nodules. Its paler scales are *sometimes* condensed into a slightly curved obscure line on either side of the prothorax, and even into just traceable blotches behind the middle of the elytra, giving the *primâ facie* appearance of a very obsolete broken fascia; and its antennæ are slender, with their third funiculus-joint elongated.

Genus 34. OTIORHYNCHUS.

Germar, Ins. Spec. 342 (1824).

51. *Otiorhynchus sulcatus**.

Curculio sulcatus, Fab., Mant. Ins. 122 (1787).

Otiorhynchus sulcatus, Schönh., Gen. et Spec. Curc. ii. 620 (1834).
—— ——, Stierl., Rev. der Otiorh. 225 (1861).

A single example of the common European *O. sulcatus*, which seems to me to differ in no respect from the ordinary type, is amongst the Coleoptera which were collected at St. Helena by Mr. Melliss; but, if truly established in the island, as the species appears to have become at the Azores, there can be little doubt that it has been naturalized accidentally from more northern latitudes.

[To be continued.]

L.—*Contributions to Jurassic Palæontology.* By Ralph Tate, Assoc. Linn. Soc., F.G.S., &c.

1. Cryptaulax, *a new Genus of* Cerithiadæ.

Cerithium, in the numerical strength of its recent and fossil species, ranks among the largest of the generic groups of Gasteropods. The number in the Jurassic rocks referred to the genus is very great, their alliance is not in all cases certain, and any steps that tend to reduce the number of species will be fraught with convenience to the working palæontologist.

Of late a few genera have been constituted out of species previously referred to *Cerithium*: Piette (1861) established the genus *Exelissa* for the reception of the somewhat pupæform *Cerithia* with an entire aperture and the last whorl cylindrical and contracted at the base. The typical species is *C. strangulatum*, D'Archiac; and fourteen species, ranging from the Middle Lias to the Kimmeridge Clay, should be referred to the genus. Lycett, in the 'Supplement to the Mollusca of the Great Oolite,' p. 93 (1863), applied to the same group the generic title of *Kilvertia*, referring to it the type species previously used by Piette: *Kilvertia* is therefore a synonym of *Exelissa*.

The British species are:—*E. constricta*, *E. pulchra*, *E. formosa*, and *E. spicula*, Lycett, sp., from the Great Oolite; *E. strangulata*, D'Archiac, sp., from the Great Oolite and Inferior Oolite; and *E. numismalis*, n. sp., from the Middle Lias.

Exelissa numismalis, n. sp.

Shell small, cylindrical, turreted, acute; whorls subrotund, longitudinally ribbed; ribs three in number, large, and coarsely nodulated, interstitial spaces very narrow; the last whorl slightly contracted at the base, the two lower ribs of the upper half often without nodules, and with a small flat rib between;

base rounded, with about three encircling ribs; suture deep and narrow; aperture orbicular; canal indistinct.

Total length ¼ inch.

Locality. Zone of *Ammonites Jamesoni*: Leckhampton Road, clay-pits, Cheltenham! (*R. T.*); Aston Magna! (*J. Slatter*); Campden! (*P. B. Brodie*).

Eustoma is another genus of Cerithiadæ founded also by Piette (1855), and in the young state resembles a *Cerithium*; but in the adult the margins of the aperture are much expanded and posteriorly united by an indistinct canal; the anterior canal is elongated. It includes *E. tuberculosa*, Piette, and *E. rostellaria*, (*Cerithium*) Buvignier, both from the Great Oolite of Ardennes.

Fibula, a third genus of the family, founded by Piette (1857), is typically represented by *Turritella Roissyi*, D'Archiac, and presents characters intermediate and approximating it to *Turritella* and to *Cerithium*. The shell is elongated, with a straight columella and a rudimentary groove near the base; outer lip arched and slightly notched at the suture. Twenty-one species, ranging from the Trias to the Cretaceous, belong here; the British forms are *F. variata* and *F. eulimoides*, Lycett, from the Great Oolite of Gloucestershire.

There remains at the least another well-marked group of Cerithioid shells, which appear to differ much from *Cerithium*, and have been referred to that genus and to *Turritella*; they present a characteristic ornamentation, have the aperture rather of *Chemnitzia*, and the posterior canal of *Cerithium*. These I propose to arrange under a new generic title.

CRYPTAULAX, nov. gen.

(*Cryptos*, hidden; and *aulax*, a furrow, in allusion to the posterior canal more or less concealed by the outer lip.)

Type, *Cerithium tortile*, Hébert & Deslongchamps, Bull. Soc. Linn. de Normandie, vol. v. (1860) t. 6. f. 1.

Shell turriculated, pointed, with a polygonal spire, ornamented with transverse costæ; angles of whorls disposed in a more or less marked spiral series; imperforate; columella straight, thin; aperture ovate, not produced into a distinct canal in front; peristome entire, broadly reflexed upon the left lip; a shallow oblique posterior canal in the angle formed by the body-whorl and outer lip.

Messrs. Hébert and Deslongchamps state that the canal of this species is so little pronounced that it might be referred to

Turritella, and that these small shells are not correctly referable either to *Cerithium* or to *Turritella*. The same characters are exhibited by *C. undulatum*, Quenstedt, which is referred by the same authors, with some doubt, to *Turritella*; they remark, further, that many allied species occur in several formations, such as the Inferior Oolite, Great Oolite, and Oxford Clay. Three of these allied species have been described by E. Eudes-Deslongchamps (1842) under *Cerithium*, but grouped together with the common characters: "*Anfractibus concavis, ad suturas elatis, testa muricata, canali subnullo.*"

The species which I refer to the genus agree in the following characters:—Test turriculate or subulate, ornamentation as described in *C. tortilis*; no anterior canal; peristome entire and broadly reflected on the columella; the posterior canal has been noticed in *C. tortilis* and *C. contorta*, but its presence in the other species is not known, they not having been examined, excepting a specimen of *C. scobina*, in which the aperture is not exposed. In *C. tortilis* the shell is porcellaneous, smooth, and shining.

Species of *Cryptaulax*:—

1. *C. tortilis* *, Hébert & Deslongchamps (*Cerithium*), *loc. cit.* Oxford Clay, inferior: Montreuil Bellay (Maine-et-Loire) (*Hébert & Deslong.*); Hutka, Poland (*Zeuschner*, Coll. Geol. Soc.).
2. *C. undulata* *, Quenstedt, sp. (*Cerithium*), Der Jura, t. 65. f. 24, p. 488 (1858). *Turritella undulata*, Héb. & Deslong. *loc. cit.* t. 7. f. 13. Oxford Clay, inferior: Montreuil Bellay (*H. & D.*); Würtemberg (*Quenstedt*).
3. *C. contorta*, Deslongchamps (*Cerithium*), Mém. Soc. Linn. de Normandie, vol. vii. p. 194, t. 10. f. 44–46 (1844). Inferior Oolite: Les Moutiers; Sully, Bayeux (*Deslong.*, *Tesson*, *Tate*).
4. *C. hystrix*, Deslong. (*Cerithium*) *loc. cit.* (1844) t. 10. f. 47, 48, p. 195. Inferior Oolite: Les Moutiers (*Deslong.*).
5. *C. scobina*, Deslong. (*Cerithium*) *loc. cit.* (1844) t. 10. f. 49, 50, p. 196. *Cerithium varicosum*, Moore, Upper and Middle Lias, West of England (1867), t. 4. f. 15, p. 83. Upper Lias: Fontaine Etoupefour (*Deslong.*); Ilminster (*Moore*). Upper Lias Sands, upper zone: Nailsworth! (*Lycett*).

* The removal of these two species from *Cerithium* will obviate a change in the nomenclature, as the specific names are already preoccupied for species of that genus.

LI.—*A Description, with Illustrations, of the Development of* Sorastrum spinulosum, *Näg.; to which is added that of a new Form of* Protococcus. By Henry J. Carter, F.R.S. &c.

[Plate XIV.]

Introductory Remarks.

On the 29th of January of the present year (1869), I collected a little of the surface-mud and water of a pool in a heath-bog about a mile from this place (Budleigh-Salterton), and, having poured it into one of those three-and-half-ounce greenish glass gum-bottles, of a pyramidal shape (that is, flat and expanded at the bottom, with a narrow mouth), in which a solution of gum is now generally sold in the shops for adhesive purposes, I submitted some of it to immediate examination; and finding that it contained many sporangia, together with large *Pinnulariæ*, I resolved to keep it throughout the spring, to see what changes might take place in either; for, from the presence also of many Desmids, especially *Closterium*, I thought that some of the sporangia might belong to the latter.

The gum-bottle was kept on a table close to a window facing due west; and time after time portions of the sediment were extracted with a dip-tube and placed under the microscope for examination, while the water in the bottle was replenished from a deep well, as required.

It was not, however, until about the second week in June that I began to find many of the sporangia developing filaments of *Spirogyra* and *Zygnema* respectively, which, accumulating, soon floated to the surface of the water in a dense mass. The *Pinnulariæ* presented no change beyond an increase of their glairy globular contents; but a great many sporangia remained, in some of which I still hoped to see the development of some Desmid.

On the 18th July this long-looked-for phenomenon seemed to present itself, by the presence *in* a sporangium under observation of a triangular organism so very like the Desmid *Staurastrum dejectum* (Ralfs, Desmid. pl. 20. fig. 5) that I made sure of having found the zygospore of at least one kind of Desmid under development.

It was not likely, therefore, that I should throw away this opportunity, and so I took the measurements of the sporangial cell and of all its contents respectively; but in doing this, it became evident to me that the triangular Desmid was not the one I had taken it for, but another, of a kind with which I was unacquainted.

This made me still more particular; and so I not only

measured, but sketched and described all the contents of the sporangial cell, when it further became evident that there was but one large triangular individual present, and that the rest consisted of groups containing eight each of the same form, but of a much smaller size.

From this period up to the 9th of August (an interval of three weeks) various interruptions prevented my return to the examination of the contents of the gum-bottle; but at this date, to my surprise, I found similar groups of the unknown Desmid, which I had previously sketched *in* the sporangium, free (that is, unenclosed in any cell whatever), much enlarged, and very numerous.

I then turned to Pritchard's 'Infusoria' (ed. 1861), and in his first plate, figs. 57 & 58, found almost identical representations of this organism, which, on referring to the text among the Desmidieæ, at p. 755, proved to be *Sorastrum spinulosum* Näg., of which it was stated "Propagation unknown," with the letter "G," indicating that it had only been found in Germany. Next I sought for it in Kützing (Species Algarum, 1849), where I found it, at p. 195, constituting a genus, but still placed among the Desmidieæ. Lastly, I consulted Rabenhorst (Flor. Europ. Algarum, 1868), where, with figs. no. 38, p. 18, and text p. 81, it is placed among the Protococcaceæ as the 49th genus of his Coccophyceæ.

Not knowing whence the figures in Pritchard had been taken, or whether *Sorastrum* had been found in the British Isles, I wrote on the subject to Mr. W. Archer, of Dublin (whose revision of the Desmidian group in Pritchard's last edition of the Infusoria has so greatly contributed to the success of this useful publication); and, in reply, Mr. Archer stated that the figures were taken from Nägeli's Unicellular Algæ (Gatt. einz. Alg. pl. 5. fig. D, *b* & *d*), but that, since they had been copied into Pritchard, Mr. Archer had seen *Sorastrum spinulosum* "many times and in various places in Ireland, but always very scant and sparing." Moreover Mr. Archer kindly presented me with copies of the 'Proceedings of the Dublin Microscopical Club' (preeminent in all matters of this kind for their accuracy and interest), wherein a "brief" description of *Sorastrum spinulosum* is given from specimens exhibited before the meeting of the Club held on the 21st Sept. 1865, p. 40, and subsequent mention of it again (having been found by the same author) at their meeting held on the 19th July, 1866, p. 101. To Mr. Archer's description I shall have again to refer hereafter; meanwhile let us return to the developmental history of those specimens of *Sorastrum* more immediately under our consideration.

Finding that I had an abundance of this organism produced in the way above mentioned, I continued to examine several of them daily, limiting myself to six dips of the the dip-tube *per diem*, and on the 10th and 11th of September saw, for the first time, a *small* group attached to a large one, in one dip, and in the contents of another dip an isolated individual of a large group with the spines on one side much retracted, and on the other side almost entirely obsolete.

Both these phenomena combined were again presented to me in the afternoon of the 17th of September; and I then succeeded in transferring the group and its now *two* young ones (baby groups) to a cell depression in a glass slide filled with water, over which a cover was placed for protection and to prevent evaporation. (I prefer the term "baby" to "daughter groups," because it will be seen hereafter that some of these groups might be spermatic elements—microgonidia.) About 7 P. M. of the same evening it was observed that two more groups had been produced, and on the morning of the following day (that is, on the 18th Sept.) that another group had been eliminated during the night, making, in all, five young groups, four of which were respectively enclosed in delicate spherical transparent capsules, all of them, no doubt, provided by the parent cell or individual. (Pl. XIV. fig. 6.)

Here the development of the baby groups appeared to cease; and on the 19th Sept. the whole was placed on the flat surface of a glass slide, for compression and final examination, when several empty individuals came into view, and the individuals of the parent group which still retained their gonimic contents were observed to have become much rounded, and to have their spines more or less atrophied.

After this, many instances of large groups were seen with baby groups about them, and one in particular in which a 16-division group of empty individuals was accompanied by from eight to ten baby groups, all in delicate capsules.

While this was going on, a dark sea-green sporangium, 13-6000ths of an inch in diameter, with gelatinous envelope, began to appear, viz. on the 6th Sept., and after this was frequently observed, which sporangium was so like in colour and contents to *Sorastrum spinulosum*, and so different from every other kind of sporangium in the gum-bottle, that I had little doubt that it was the impregnated sporangium of our *Sorastrum*. But, as this identity will come out better by the descriptive detail of this development in the summary of my observations which follows, I will add no more here than that the presence of this spore seemed to terminate, for this year, all that I was likely to see in the development of this little

plant. The large groups, the baby groups, and the said sporangia all abounded in the gum-bottle at the end of Sptember.

Summary of Observations.

We will divide the development into four stages, viz.:—1st, the development of the groups of *Sorastrum* from the sporangium; 2nd, the growth of these groups; 3rd, the production of the baby groups and consequent evacuation of the gonimic contents of some of the individuals of the parent group, together with the retention of these contents by others, accompanied by change in figure of the body (inflation) and atrophy of their spines; and, 4th, the formation of the sporangium.

1. On the 18th July, a spherical transparent cell, 18-6000ths inch in diameter, was observed in a drop of the sedimentary contents of the gum-bottle mentioned, which contents had been placed under a microscope for examination. This cell contained fifteen spherical groups of the compound *Protococcus* called *Sorastrum spinulosum*, Näg., each group consisting of eight individuals and one large individual by itself, thus dividing the contents of the sporangial cell into sixteen portions. Each of the groups was 5-6000ths inch in diameter, and each individual composing them about 2-6000ths inch broad, while the single individual was 4-6000ths inch broad (Pl. XIV. fig. 4). The centre of the sporangial cell was occupied by another spherical cell (*e*) 3-6000ths inch in diameter, which, again, was apparently filled with small cells around one a little larger, which was in the very centre of all; while from the spherical towards the confines of the sporangial cell were seen the remains of the radiating branched septa (*f*), which originally divided the contents of the sporangium into sixteen compartments.

2. On the 14th August following, a great number of free groups (that is, without cell-envelopes) were seen, averaging 8-6000ths inch in diam., exclusive of the spines, and composed respectively of eight, sixteen, and thirty-two individuals, of which each individual averaged 4-6000ths inch broad (fig. 1). The largest groups measured 16-6000ths inch in diameter, and the largest individuals 5-6000ths inch broad (figs. 2 & 3).

3. On the 10th of September, baby groups began to appear in connexion with the large groups; and one of these groups, where there were two baby groups present, was transferred for further observation to a cell depression in a slide covered with a thin bit of glass, as before stated, for protection and to prevent evaporation. Here, in the course of twelve hours afterwards, three more baby groups were produced, making in all five, of which four were composed of sixteen individuals each,

and each group eliminated in its proper cell, while the other group, consisting of eight individuals, appeared to have lost its cell, and presented a tendency to disintegration or separation of its individuals. All these groups were 3-6000ths inch in diameter, exclusive of the cell (which was a little larger), and the individuals composing them 1½-6000th inch broad, while the individuals of the parent group averaged 5-6000ths inch broad.

When all development of the baby groups appeared to have ceased, the whole was transferred to the level surface of a glass slide and compressed, in order that the total number of individuals in the parent group might be ascertained, if possible, together with the number of those which were empty and collapsed and of those which still retained their gonimic contents, for the purpose chiefly of ascertaining the relation in number of the five baby groups to that of the individuals of the parent group (fig. 6). This gave two of the former (*b b*), seven of the latter (*a*), and five baby groups (*c*); but, as will presently appear, all the empty individuals were not visible. (See all this delineated in fig. 7.)

Further, to ascertain the alterations in form which the individuals still retaining their gonimic contents had undergone in their cell-walls and spines respectively, as there was already evidence of something of this kind having taken place, and to determine, if possible, how many individuals composed the original group, the whole was subjected to a still greater amount of compression, viz. sufficient to burst the green individuals and get rid of their contents (fig. 7), when it was observed that, in addition to these seven (*a*), there were the cells of *four* empty collapsed ones, and the remnants of some more which had never been fully developed, or, if so, had only left fragments of their cells attached to the rest (*b b*).

Thus there was evidence of four distinct empty cells and the remains of some others; so that the original group, probably, belonged to the 16-division.

This was not all; for the cell-walls of the green individuals had not only become larger, rounder, and more inflated by an actual increase in their gonimic contents, but the spines in several of them had become so far atrophied that here and there they were entirely gone or represented only by a little papillary eminence (*c c*)—an alteration which had previously been witnessed in isolated individuals drawn up among the sediment by the dip-tube.

I have already mentioned the appearance of another group of sixteen individuals (or of the 16-division *cell*), the whole of which were collapsed and empty, with the presence of from eight

to ten baby groups around them, while the phenomena of enlargement, approach towards a globular form, and atrophy of the spines have just now (October 19th) been most satisfactorily seen in one group of eight and in three groups of sixteen cells each. (These specimens were taken from another gum-bottle, in which a little of the sediment of the original one had been placed about two months since, together with some small bits of the jelly of *Ophrydium versatile*, and where *Sorastrum*, thus transferred, has multiplied as much as in its original bottle, with even more robust dimensions.)

The sediment of the original gum-bottle now became charged with the old (fig. 1) and the new (fig. 8) groups of *Sorastrum*, so that from six to ten old and young might be counted in each drop of the sediment when placed on the slide for examination.

4. To those who had observed the contents of any algal cells (especially those of the so-called unicellular Algæ), respectively divided up into microgonidia and macrogonidia, and the former swarming round and passing into the latter for impregnation, as in *Cryptoglena lenticularis*, Cart. (Annals, ser. 3. vol. ii. pl. 8. figs. 18–27), it would not be unlikely that, on witnessing a similar elimination in *Sorastrum spinulosum*, this should also be set down as the time for impregnation and formation of the spore. Hence I was not surprised to see for the first time (viz. on the 6th of September) a spherical sporangium, 13-6000ths inch in diam., densely filled with gonimic contents presenting a deep dark sea-green colour, precisely like that of the groups of *Sorastrum*, and totally different from that of everything else in the gum-bottle (fig. 9).

Moreover, on minutely examining this sporangium, it was observed to be invested with a soft gelatinous transparent envelope (*a a*), and to possess a tough transparent coat (*b*), which, when burst, was found to be filled with the usual contents of a sporangium, viz. minute grains of starch, chlorophyll, oil-globules, &c., but no distinguishable nucleus.

Subsequently this sporangium became more abundant, and in some cases double, but always presented the same size and other characteristics mentioned, with the exception that occasionally it appeared to be a little elliptical.

How and when this sporangium was produced, assuming it to be that of *Sorastrum*, I can only conjecture from the resemblance of the baby groups eliminated in the third stage, corresponding to that which I had seen to be the moment of impregnation in the unicellular Alga to which I have alluded, where some of the groups eliminated were in the form of microgonidia and others in that of macrogonidia, *i.e.* of minute

spermatic elements, ciliated and active, and of larger germic ones, entirely passive. Hence the reason, to which I have before alluded, for using the term "baby" instead of "daughter groups" for those thus eliminated from *Sorastrum*.

How, again, to give a right interpretation to the alteration in the form of the individuals of the parent group which retain their gonimic contents, and lose their spines, apparently by atrophy, I am ignorant. This may be a passive or winter form assumed by the individual; or if, as in *Œdogonium* (see my figures, 'Annals,' ser. 3. vol. i. p. 29), a kind of micropyle or opening is formed in the original cell-wall for the entrance of the microgonidia to the spore, then the enlarged green individuals, which become rounded and lose their spines, may be females becoming impregnated and thus passing into sporangia instead of into passive winter forms. But, in the absence of more decided proof, I must leave the reader, in this matter, to his own conjecture, merely adding that in no instance have I seen the cuneate individual of a parent group producing a series of baby groups endogenously or within its cell-wall, arranged around a central cell, like that observed in the sporangial cell (fig. 4). Nor have I ever seen an individual of a parent group undergo binary division or fissiparition to increase the number of individuals in that group, although it might be conceived that the bilobate condition which I shall have to notice presently might easily lead to this kind of multiplication.

Thus ends the development of *Sorastrum spinulosum*, so far as I have been able to pursue it. The formation of the sporangium brings us back to that stage which was witnessed on the 18th of July last, where we found the sporangial cell producing sixteen groups; and we must wait for July of 1870, probably, to verify the conclusion that the sporangia now presenting themselves are really those of our beautiful little *Sorastrum*. Meanwhile I hope to keep all safely, with occasional examination, until that time arrives.

Species.

It is too much the custom with naturalists to give a name to every new organism of which they have caught but the merest glimpse and could make the roughest representation. Then comes a second, who sees more of the same organism, and therefore gives it another name, and so on; there may be a third, or more, increasing in a short time the synonymy to such an extent that, with myself, it often threatens to paralyze all further efforts at investigation where it occurs. And where

does it not in the *après-moi-le-déluge* system of those reckless *soi-disant* "naturalists" whose chief object is to see their names dangling after a description oftentimes incomplete and sometimes even culpably imperfect?

I do not mean this to apply to the present instance; but when one reads in Mr. Archer's faithful description of *Sorastrum spinulosum* (Proceed. Dublin Microscop. Club, 21st Sept. 1865, p. 40), that, although each individual of the group of *Sorastrum* possesses four spines, when one individual "presents its broad or cuneate side to the observer, it often happens that only two spines seem to exist, as one is behind and hidden by its companion" (a condition which I myself have often witnessed)—again, when one sees that the individual of *Sorastrum spinulosum* is often "bilobate," as represented in fig. 5 (*a*), perhaps from atrophy, as the reverse becomes the case in robust individuals (*b*, *c*, *d*), one cannot help thinking that, in these two conditions combined, it is just possible that Meneghini's *Sorastrum echinatum* (Synops. in Linn. xiv. p. 238. n. 4) of 1840 may be Nägeli's *S. spinulosum* (Einz. Alg.) of 1849 and Rabenhorst's *S. bidentatum* (Flor. Europ. Alg.) of 1868—all phases of one and the same individual which I have often seen manifested among the different groups of the *Sorastrum* under consideration, and therefore trifling differences which I do not think warrant the separation.

If priority of notice gives precedence, then it seems to me that Meneghini's name of *Sphærastrum echinatum* for this little plant should be retained. Kützing, also, has changed "*Sphærastrum*" to "*Sorastrum*," or at all events adopted Nägeli's appellation (which is the latter) for the genus.

Making a "heap" of it, instead of a "sphere," seems to me like requiring a little more when enough has been attained, or risking the substance for the shadow—a course which too often breaks down the memory with disgust, and, if continued, must sooner or later be altogether suicidal to natural history.

There is one point, however, in which all the representations and descriptions of this little organism appear to be deficient, viz. in the mention of a stipes (fig. 2 *a*), whose presence, as my figures will show, necessitates the addition of "stipitate" to its cuneate outline.

From the triangular form of, and spines on, the individual of *Sorastrum*, resembling especially *Staurastrum avicula* and *S. dejectum* (Ralfs, Desmid. pl. 23 and pl. 20, figs. 11 & 5 respectively), it has hitherto been placed among the Desmidieæ; but the latter, although much about the same size as the cuneate individual of *Sorastrum*, appears in pairs, united by a

bond of attachment which extends from centre to centre of the proximate flat triangular sides of the divisions, while two pairs unite to form the zygospore, which is echinated. On the other hand, the individual of *Sorastrum* is spined *only* at two ends, the other corner of the cuneate cell being stipitate, while in its normal condition it forms one of a group of eight, sixteen, or thirty-two individuals. The latter, again, do not appear to undergo binary division, but produce one or more baby groups of *Sorastrum*, and, if we are right in our conjecture, a smooth sporangium, formed probably from the impregnation of a macrogonidium by microgonidia.

Thus the former, by its zygospore, is essentially a Desmid, and the latter, by its mode of generation, essentially allied to *Pediastrum* (see A. Braun's figures &c. of the development of *Pediastrum granulatum*, pl. 3, in 'Rejuvenescence of Nature,' translated in Botanical Reports by Henfrey, Ray Soc. Pub. 1853)—a view at which Mr. Archer had also arrived by having frequently witnessed the evolution of young groups from *Cœlastrum* and *Scenedesmus*. Hence, in his last letter to me, this able authority states:—"At present, and so far as observation has yet gone, I could assume *Sorastrum* (as well as *Pediastrum*, *Cœlastrum*, and *Scenedesmus*) as not belonging at all to the Desmidieæ." Of course the observations which have led to this conclusion have been made since the last edition of Pritchard was published, in which these genera are all placed by Mr. Archer, as heretofore, among the Desmidieæ. Further, Mr. Archer's present view is also corroborated by Rabenhorst, who (*op. cit.* 1868) has assigned all these genera to his family of Protococcaceæ.

(It is curious, too, as showing the gradual development of our knowledge in these respects among people widely separated and without intercommunication, although probably of contemporaneous education previously, in the same kind of seminaries, that, in the month of June 1861, I had myself made drawings of *Pediastrum*, *Scenedesmus*, &c., to show at some future period that these organisms belonged rather to the Protococcaceæ than to the Desmidieæ.)

Although, however, Rabenhorst figures and places all these genera under his family Protococcaceæ as "*Algæ unicellulares sensu strictissimo*," still a group of eight, sixteen, or thirty-two individuals linked together in the form of *Sorastrum* can hardly be considered "unicellular," any more than the concatenated cells of a filament of *Spirogyra*. But, be this understood as it may, these organisms, for reasons above stated, undoubtedly belong much more to the Protococcaceæ than to the Desmidieæ.

General Observations.

Thus we have seen (1) that the development of *Sorastrum spinulosum* commences by a division of the contents of the sporangium into sixteen portions or family groups of eight (sixteen, or thirty-two?) individuals each; (2) that, after elimination, these groups increase in size, but not in number of individuals, so far as my observation extends; (3) that certain individuals produce one or more family groups of eight, sixteen, or thirty-two individuals each, in cells respectively provided by the parent, which are deciduous (that is, subsequently soon disappear); (4) that those individuals of the parent group which do not produce new families retain their gonimic contents, increase in size, become globular, and lose their spines by atrophy; (5) that a spherical or slightly elliptical sporangium, about twice the diameter of the largest individual of a group of *Sorastrum*, makes its appearance, presenting a deep dark sea-green colour, precisely like that of *Sorastrum*, composed of a tough, transparent coat filled with the usual contents of a sporangium, and surrounded by a thick, soft, transparent, gelatinous envelope.

It may now be asked, upon what grounds I assume that the first development of *Sorastrum* witnessed was that of the sporangium. To which it may be replied, that it presented features which none of the other developmental forms possessed, viz. a large spherical cell containing sixteen family groups, while no other but the "baby" group was enclosed in a proper cell, and the cell of this group was deciduous. Again, no other developmental form of the kind presented itself after the 18th July; but, on the contrary, a great number of groups of eight, sixteen, and thirty-two individuals made their appearance, followed, after the 10th of September, by a still greater number of baby groups which *they* produced. Hence there was a direct sequence in the appearance of the sporangium, the free parent groups, and the baby groups respectively.

A more perplexing question, however, is the signification of the increase of size, rounded form, and atrophy of the spines in those individuals of the group which retained their gonimic contents but did not produce baby groups. This I cannot answer further than that these may pass into winter forms, or, being impregnated, resolve themselves into sporangia.

Nor has the mode of impregnation been witnessed. But here, I think, it may be fairly assumed, from what has been seen in the impregnation of a unicellular Alga (Annals, *l. c.*), that, on the evolution of the gonimic contents (in September)

in the form of small groups of still smaller individuals (although, perhaps, of different sizes in their respective groups, as the latter consisted of eight, sixteen, or thirty-two individuals), we had the elements of impregnative generation, at least the spermatic or microgonidia, if not the germic or macrogonidia also—some of which groups retained their figure entirely, and increased slightly in size, while others became disintegrated. The former having lost the cells provided by the parent, respectively remain on in the gum-bottle; but whether they will live to go through the winter, growing into large groups for further development next year, has yet to be proved, while on the other hand, they may all perish, and the individuals of the parent groups *alone* form the winter or passive stock. The latter were too minute to follow; indeed it was difficult, from their smallness, to conjecture even the total number in each group. They, on separation, might have become ciliated and active, for the purpose of searching out the female passive cell; but although in one or two instances I saw them after disintegration, they had then a globular shape, but were stationary—that is, evinced no movement. These disintegrated stationary ones, too, were probably abortive; for when in full force and normal development, the spermatic cells bound off from the disintegrating group in quest of the passive females ready at the same moment to receive them, and soon disappear, either by entering into them or by becoming still forms (that is, losing their cilia) from failing of their object, and thus, sooner or later, perishing altogether. Hence, except by a stroke of great good fortune, it is almost impossible to follow them after they have left the parent group.

How beautifully is the object of Nature obtained by making only one element of impregnation active! Conceive the confusion that might exist were both elements active in vegetable infusions, where such beings are almost as thick as grains of sand on the sea-shore, and in species almost as infinitely numerous.

Lastly, we come to the formation of the sporangium, which was first seen, on the 6th of September, almost synchronously with the evolution of the baby groups and the change of form &c. in the individuals of the parent group which did not part with their gonimic contents, or, in other words, whose contents were not evolved in the form of the baby groups. And this brings us to the question whether these individuals are female cells, and whether their impregnation takes place through some preparatory opening in their cell-wall, to form the sporangium, or whether the contents of the individual are first eliminated in the form of a free macrogonidium, to receive the

spermatic element *outside the old* cell, as in *Cryptoglena lenticularis* (Annals, *l. c.*).

I confess that the changes which take place in the individuals which do not send forth their contents in the form of baby groups now inclines me to think that the sporangium may be produced after the plan first mentioned. But it will be seen that this is a point still undecided, and, as before stated, one which nothing but a stroke of great good fortune can determine.

It might be asked, also, what are those little cells seen in the central cell of the sporangium under development, and in the central cell also of the groups respectively (figs. 4 & 5, Pl. XIV.)? In the first place, are they cells, or are they circular marks resembling cells, produced by the attachment of the expanded podal ends of the stems of the individuals of the group, respectively, on the central cell? I incline to the latter view, but admit that I am still in doubt as to the real nature of these apparent cells.

Do the individuals which produce baby groups produce more than one, as the cells of *Pediastrum granulatum* (see A. Braun's figures, *l. c.*)? Yes. In the group with two baby groups, which I placed aside for examination, one of the parent individuals was but half emptied, and the following morning it was wholly so, while at the final examination there were only four empty cells and five baby groups. Hence one must have produced two; and this probably was that which at first I saw half-emptied—that is, still retaining another baby group. It is possible, and probable too, therefore, that one parent individual may produce a plurality of baby groups, as in *Pediastrum*.

Thinking that *Sorastrum spinulosum* might be found in the pond of the heath-bog from which was obtained the original sediment in which it was developed in the gum-bottle, I sought for it there about the time that it was most numerous in the latter, but failed to find it anywhere. It is true that the original pool had been drained; but there were several other depressions of the same kind, in the same locality, filled with bog-water, which, on microscopical examination, did not yield a single specimen.

Before concluding this communication, I have to allude to a green *Protococcus* which I found singly and undergoing subdivision in a tank in the Island of Bombay in June 1861, viz. at the time I was led to the view, already noticed, that *Pediastrum*, *Scenedesmus*, and other forms of the kind present in the same

tank belonged to the Protococcaceæ rather than to the Desmidiaceæ.

The peculiarity in this *Protococcus* was, that it presented a conical elongation of, or appendix to, its cell, comet-like, not only in its single form, but throughout all its subdivisions—a feature which I had not previously seen, and which, as it does not appear to have been recorded by others, seems deserving of the accompanying delineations (Pl. XIV. figs. 10–20) and of being described under the following appellation:—

Conococcus elongatus, mihi.

Passive form unicellular, with the usual green contents and nuclear (?) vesicle of such organisms enclosed in a spherical cell, to which is appended a transparent conical extension or appendix three times the diameter of the cell in length. Conical extension persistent in all the individuals of its various subdivisions. Size of single largest cell 4-5600ths of an inch in diameter.

Hab. Fresh water.

Loc. Tanks in the Island of Bombay.

Obs. Sometimes, as in fig. 18, the gonimic contents of the cell are partially extended into the conical appendix; or they may be extended throughout that of one individual only (fig. 19); or they may be extended throughout the whole in the eight-cell division or group, as in fig. 20. Hence the appendix here is actually an "extension" of the cell-wall.

This is the form which I have figured and to which I have alluded in the 'Annals' of April last (1869), pl. 17. fig. 21. I have never seen it in its active state, and am still inclined to think that it may be but a sportive form of the "*Chlamydococcus*" represented in the 'Annals' of 1858, vol. ii. pl. 8, which is the common or usual figure of this unicellular Alga in the tanks of Bombay.

Postscript.

Since the above was written, the question of fissiparity in *Sorastrum* seems to be determined in the affirmative; for on the 30th October a group of eight robust individuals was observed, in which one was much larger than the rest and almost spherical in shape, simulating the roundness and appearance of a sporangium; but, on evacuation of its green contents, the cell-wall was found to present four pairs of spines, situated, apparently, opposite to, and equidistant from, each other, thus indicating the preparatory stage to fissiparition or binary division. It is right, however, to add that only seven spines were actually visible, and that the unseen one of the fourth

pair, if present, was probably concealed behind its companion.

This group was found among the portions of jelly of *Ophrydium versatile* &c. which had been placed in the second gum-bottle mentioned, together with another group consisting of *four* individuals. Indeed, as I have before stated, the second gum-bottle now furnishes the finest groups of *Sorastrum*, both collectively and individually, the former being, for the most part, 13-6000ths inch in diameter, and the individual cell upwards of 5-6000ths inch broad. If the individuals of a group have become unusually large and rounded (that is, 6-6000ths inch in diameter), very slight pressure seems to separate them, when they leave their stems behind and present such an even round outline, in lieu of the cuneate extremity, that no one would suppose there had ever been a point of attachment there, although the spines still remain the same; and this, perhaps, may account for the absence of the stem in Nägeli's and Rabenhorst's figures respectively. The reverse is the case in the earlier part of their career, where the group may be torn to pieces, but the stems remain almost inseparably attached to the individuals.

I have now seen, at one time or another, individuals singly, and in groups of two, four, eight, sixteen, thirty-two, and, I think, sixty-four, which, with the enlargement of the single individual of the group of eight mentioned, and its four pairs of spines, &c., leads to the following inferences:—

That *Sorastrum* may increase by binary division like other unicellular Algæ of the kind; that this may take place in a single individual isolated from the main group (which might thus originate a new group), or in a single individual while attached to the main group, or in all the individuals of a group synchronously; that the enlarged and rounded state of the individual, and not the more or less bilobate form, indicates the preparatory stage to binary division; that, as a single individual of a group may precede the rest in binary division, so the groups may not always be a multiple of 2, although generally so, nor have 2 for a common multiplier (that is, that one individual only of a group of eight, dividing, would give nine, &c.); that, contrary to what has been before inferred, the groups need not always contain the same number of individuals as when first eliminated from the sporangium, but may be increased in this respect by binary division, after elimination; that the enlargement and sphericity of the individual therefore may not lead to the formation of the sporangium, whatever the atrophy of the spines may indicate, while, on the other hand, the contents of the individual may be liberated from

its cell in the condition of a macrogonidium, singly or in plurality, previously to impregnation and the formation of the sporangium, as in *Cryptoglena lenticularis* (*l. c.*) and other Algæ of the kind; lastly, that the facility with which the enlarged and rounded individuals of a group may be separated indicates that this may take place naturally, and thus that each individual may originate a new group, also as in unicellular Algæ generally.

EXPLANATION OF PLATE XIV.

All the figures of *Sorastrum spinulosum*, Näg., are drawn on the scale of 1-6000th to 1-12th inch, in order that their relative sizes may be seen. *Conococcus elongatus*, n. sp., fig. 10, is on the scale of 1-5400th to 1-12th inch; figs. 11 & 12, 1-5400th to 1-24th inch. The rest of the groups were all smaller in size, although their cells individually might, on separation, attain much larger dimensions.

Fig. 1. *Sorastrum spinulosum*, Näg., typical form of cœnobium or group of sixteen individuals; average size 8-6000ths inch in diameter.

Fig. 2. The same, individual of largest size separated from the group, showing the body containing nuclear (?) vesicle: *a*, stipes. Size 5-6000ths inch broad by 4-6000ths long; spines and stipes each 1½-6000th inch long.

Fig. 3. The same, end view, outer side.

Fig. 4. The same, sporangium, 18-6000ths inch in diam., undergoing development of its contents internally, presenting fifteen groups of eight individuals each and one single individual, = sixteen groups, but here represented with four groups only, for perspicuity, viz. two of sixteen individuals each (*a a*), each group 5-6000ths inch diameter and each individual 2-6000ths broad, one of eight individuals (*b*) of the foregoing diameter and breadth of individual respectively, and one single individual (*c*) 4-6000ths inch broad. The four circles (*d d d d*) are intended to show the position of some of the other groups, of which the whole (viz. sixteen) were respectively developed in separate compartments indicated by the septal lines (*f*) extending outwards from the central cell, which groups, though actually all seen by alteration of the focus of the microscope, could not be delineated altogether, and were too indistinct and confused to admit of anything but the arbitrary and imaginary arrangement of them given in the figure. Central cell (*e*) spherical, 3-6000ths inch in diameter, representing a central circular area surrounded by a number of smaller cells.

N.B. In my original Notes, the whole of the groups in this sporangium, with the exception of the single individual (*c*), are set down as containing only eight individuals each; but as many of the groups subsequently seen in the contents of the gum-bottle consisted of sixteen or thirty-two individuals, and these seemed to have come originally from sporangia of the same kind and in the same way, I have delineated two of the groups (*a a*) with sixteen instead of eight individuals each, conjecturally.

Fig. 5. The same, a group of six individuals of the largest size, which was separated from one of sixteen individuals, showing the manner in which the stipes is attached to the central cell, which here appears also with the central area and its surrounding cells: *a*, bilobate form of individual; *b*, *c*, *d*, showing gradation of the outer profile of the cell from concave to convex, following the more or less robust state of the individual, purposely drawn in this way to point out how different the form of an individual cell of the same *Sorastrum* may be under different circumstances, even in the same species.

Fig. 6. The same, group of large individuals from which several baby groups were developed, showing seven individuals still filled with gonimic contents (*a*), two empty collapsed ones (*b b*), and five baby groups (*c*), all of which have (for particular examination) been more or less separated by pressure from their original grouped arrangement. Baby groups 3-6000ths inch in diameter, individuals 1½-6000th inch broad: four groups eliminated in parent cells respectively, *c*; and the other consisting of a group apparently of eight individuals free (that is, with no enveloping cell), *d*.

Fig. 7. The same, the foregoing group with the large individuals only, viz.:—those which still retained their gonimic contents (*a*) and those which were collapsed and empty (*b b*); the contents of the former eliminated to show their rounded, altered forms and more or less atrophied spines, respectively (*c*, *c*, &c.); also two more empty and collapsed individuals, making in all four from which the baby groups had been eliminated; lastly, the fragmental remains of some cells (*d*) which may or may not have been originally developed in this group, which thus seems to have belonged to the sixteen-cell division.

Fig. 8. The same, baby group to compare with that developed from the sporangium, fig 1; size of baby group 3-6000ths inch in diam., individuals 1½-6000th inch broad each.

Fig. 9. The same, form and size of assumed sporangium, filled with gonimic contents of a deep dark sea-green colour, like that of the *Sorastrum*-group, 13-6000ths inch in diameter: *a a*, gelatinous capsule about 3-6000ths inch thick; *b*, proper coat of sporangium.

Fig. 10. *Conococcus elongatus*, n. sp., single cell, 4-6000ths inch in diam., filled with gonimic contents including nuclear (?) vesicle, showing also the peculiar conical extension of the cell-wall.

Fig. 11. The same, in binary division; 12, binary division, with subdivision of conical extension preparatory to quadruple division; 13, quadruple division; 14, eight-cell division; 15, sixteen-cell division; 16, cell-division in four tetrahedral groups of four cells each, sportive form; 17, irregular sixteen-cell division; 18, eight-cell division, with partial extension of the gonimic contents into *all* the radii; 19, eight-cell division, extension of the gonimic contents throughout in one radius; 20, eight-cell division with complete extension of the gonimic contents throughout each radius. The last four groups, including the radii, 6-5400ths inch in diameter.

LII.—*Descriptions of two new Species of Sun-birds from the Island of Hainan, South China.* By Robert Swinhoe, F.Z.S.

Æthopyga Christinæ, n. sp.

Crown of the head and back of the neck deep purplish black, with beautiful dark metallic-green and coppery reflections; sides of the face and neck, and the back, of the same colour without reflections; throat and breast rich maroon-red, the former flanked along the maxillæ with a line of dark roundish feathers shot with steel-blue, green, and purple. Scapulars rich brownish olive, the same colour tinging the black of the back, and becoming greener as it broadly edges the wing-coverts and secondary quills. Feathers of the wing hair-brown, the primaries only slightly edged with olive. Rump canary-yellow. Upper tail-coverts, two central tail-feathers, and outer edge (more or less) of all the rest but the outer feather glossy metallic dark green; under part of central rectrices and the main portions of all the others black, the three outer ones being tipped with white increasing in extent to the outer feather. Tail of twelve graduated feathers, the two central with elongated tips. Below the maroon breast crosses a band of olive-green, fading into the dingy yellowish white of the under parts. Axillaries white, with a primrose wash; inner edges to quills creamy white.

Bill blackish brown, paler on the lower mandible. Irides deep brown. Legs leaden grey, with brownish claws.

Length about $4\frac{1}{4}$ inches; wing 2; tail 2, including the protracted tips, which measure $\frac{4}{10}$; bill from forehead $\frac{5}{8}$, well curved, and somewhat thick.

I procured this novel and beautiful species in the mountainous region of central Hainan. The above description is taken from three male specimens. I unfortunately did not succeed in procuring a female.

Arachnechthra rhizophoræ, n. sp.

Closely allied to *A. flammaxillaris* from the Tennasserim provinces, from which it differs by having the forehead to the top of the crown black, with steel reflections of purple, blue, and green.

Length about $4\frac{1}{4}$ inches; wing 2; tail $1\frac{5}{12}$; bill $\frac{5}{8}$, bending downwards from its middle.

This is a very common species throughout Hainan, among the mountains as well as among the marshes of the coast.

MISCELLANEOUS.

Observations on the Zoological Characters and Natural Affinities of Æpyornis. By MM. A. Milne-Edwards and A. Grandidier.

M. A. Grandidier has made some excavations in marshy ground at Amboulitsate in Madagascar, and obtained bones of *Æpyornis.* These bones are :—1st, a perfect tibia and several fragments of that bone; 2nd, a nearly complete femur; 3rd, two vertebræ; 4th, a tolerably well preserved femur and fragments of the same bone belonging to smaller individuals of *Æpyornis*; and, 5th, a very imperfect femur belonging to a still smaller specimen. The authors notice briefly the peculiarities presented by these bones.

The tibia is enormous, and has its articular extremities singularly enlarged. Its length is 64 centimetres, the circumference of its upper extremity 45 centimetres, and that of its inferior 38, the body of the bone in its most contracted portion being only 15½ centimetres round. The characters of the bone prove at once that it belonged to a bird of the brevipennate order. It differs from the tibia of *Dinornis* and *Palapteryx* in having no osseous bridge over the groove of the extensor muscle of the toes, in this respect agreeing with the existing Brevipennes; but the general proportions of the bone are quite different. The tibia is more massive than even that of *Dinornis elephantopus.*

The largest femur found at Amboulitsate seems to agree, in the dimensions of its articular surface, with the tibia just mentioned. The proportions of this bone are very singular; its thickness is extraordinary, whilst in length it does not measure one-half more than its lower extremity. Behind and above the condyles there is an enormous pit, into which open large orifices for the admission of air into the interior of the bone. These orifices are absent in *Apteryx* and *Dinornis.*

A fragmentary tarso-metatarsal bone has been received by the Museum of Paris from M. Liénard since the publication of the observations of M. Geoffroy St.-Hilaire. The authors state that this bone shows a remarkable widening, combined with a very distinct flattening, in an antero-posterior direction. The width of the diaphysis at its narrowest point is 8 centims., whilst in *Dinornis giganteus* the width of this part is only 5¼ centims. As the last-named species attained a height of 3 metres, it was concluded, from this difference in the tarso-metatarsus, that *Æpyornis* must have been at least 3·60 metres in height. This measurement, however, is deceptive as a basis for calculating the size of the animal. At the upper extremity of the tarso-metatarsus are the two furrows which indicate the original separation of the three elements of the metatarsus; and as these occur only immediately below the articular extremity, the bone must be very nearly complete. Its length could not have exceeded 38 centims. The investigation of this bone is considered by the authors to show the alliance of *Æpyornis* to *Dinornis*; and they entirely reject M. Bianconi's opinion that

Æpyornis was a rapacious bird, probably identical with Marco Polo's roc. The absence of the hind toe seems to set this question at rest. The probable height of the bird is 2 metres, about equal to that of a large ostrich; but, although it can no longer be regarded as the tallest, it is at present, say the authors, "the stoutest, the most massive, and the most *elephantine*" of known birds.

M. Grandidier's excavations furnished remains of several smaller species of *Æpyornis*. One of these (called *Æ. medius*) would appear to have been of the size of the cassowary; another (*Æ. modestus*) about as large as the great bustard. Thus there was formerly in Madagascar a population of large terrestrial birds, resembling in their structure the *Dinornis*, *Palapteryx*, and *Apteryx* of New Zealand.—*Comptes Rendus*, Oct. 11 1869, pp. 801–805.

Reptile Remains and Climaxodus.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In your issue for June last, you kindly permitted me to describe a reptilian bone from the Northumberland Coal-measures. In the short communication referred to I described the bone as a malar of a Coal-measure Labyrinthodont.

In your October issue Messrs. Hancock and Atthey, who have contributed several papers to your pages, expressed their non-acceptance of the correctness of my interpretation of the bone in question, and adduced reasons for believing that it is the cranial shield of *Anthracosaurus*.

During my examination of the specimen I was not without doubt respecting its identity; and had the two sides of the plate of bone been more nearly symmetrical, and the orbital spaces more perfect and more nearly opposite to each other, I should have inferred that it was a median bone. I have now, however, had all doubt as to the character of the fossil removed, having had the opportunity of inspecting a far more perfect cranial shield of a similar reptile, which shows that some of the processes have been broken off that in my possession, and that, by pressure or otherwise, its form has to some extent been altered. I therefore take the earliest opportunity of frankly acknowledging the general correctness of the criticisms of the writers alluded to.

Since writing the foregoing, I have seen an article by Messrs. Hancock and Atthey in the November 'Annals and Magazine of Natural History' on *Climaxodus* and *Janassa*, in which the writers endeavour to prove that the teeth which have been so named belong to the same genus. The specimens in my possession and those in the cabinets of three other palæontologists do not corroborate the opinions the writers have expressed. I have several specimens of *Climaxodontes*, varying in length from 1 inch to ½ an inch; yet they have an equal number of ridges, and are not twisted and bent in the unsymmetrical manner represented in the ideal group of seven by which the article is illustrated. As I have not, however, obtained

any specimens in groups, I shall not venture to express a positive opinion upon the supposed identity between the two genera. I desire to offer a few observations upon a reference to two names I gave to two species of *Climaxodus*, and to the contents of a footnote on p. 328 of the 'Annals' for November. In reply to those paragraphs, I have to state that the specimen of *Climaxodus ovatus* which was named by me before a large audience in the Lecture Hall of the Mechanics' Institution, Newcastle-on-Tyne, on Sept. 28, 1868, is now in the British Museum, and that a specimen marked by Messrs. Hancock and Atthey *Climaxodus linguæformis* is now on the shelves of the Museum of the Natural-History Society, Newcastle-on-Tyne. Although there is a general resemblance between them, there is sufficient dissimilarity to justify their being provisionally named as different species. The specimen I named *Climaxodus vermiformis* (Geological Magazine, Aug. 1869, p. 381) is less like *C. linguæformis* than is *C. ovatus*; and how Messrs. Hancock and Atthey, who have never seen the latter specimen, can say that it more nearly resembles *C. linguæformis* than does *C. ovatus*, I am at a loss to understand.

The substance of the footnote appended to Messrs. Hancock and Atthey's paper amounts to this. *C. ovatus* and *C. linguæformis* were published at the same date, Nov. 1; but Mr. Atthey read his paper on Oct. 9, and there is no satisfactory evidence that I publicly named *C. ovatus* at an earlier period. I have to confess myself a little surprised at this statement. It was my opinion, until I read Messrs. Hancock and Atthey's paper, that scientific men gave each other credit for speaking the truth in relation to matters of fact; and when I stated, in the 'Geological Magazine' for Nov. 1868, that I had publicly named and described *C. ovatus* on the 28th of Sept., it occurred to me that that statement was sufficient evidence of its truth. It is not, however, to Messrs. Hancock and Atthey; and it may not *now* be to readers of the 'Annals' with whom I am not acquainted, and who have seen my truthfulness impugned. What do Messrs. Hancock and Atthey consider evidence, and what to them is publication? The papers of the Tyneside Naturalists' Field-Club are generally read to about twenty Members; the address I delivered was to an audience of about 400 persons; and surely Mr. Atthey's unannounced paper, read before a small number of persons, almost in darkness, in a remote sea-side inn, was not more prominently brought forward than was my statement delivered eleven days previously to 400 persons in one of the chief institutions in Newcastle-on-Tyne, with the specimen exhibited, and with illustrations of the form and chief characteristics of the tooth sketched on a large blackboard. Messrs. Hancock and Atthey say, that were my statement even correct it would be no such publication of species as to secure priority; and then, as though they desired to convey the idea that it was not "strictly correct," they say, "Where, however, is the record either naming or describing at this time *C. ovatus*? We have searched for it in vain."

The evidence, in addition to my testimony, might easily have

been obtained, had it been honestly searched for; in proof of which I refer to the following gentlemen who were present at the lecture, all of whom are well known in Newcastle-on-Tyne, and any of whom will testify to the strict truth of this statement:—T. L. Gregson, Esq., Sheriff of Newcastle-on-Tyne, Chairman; Messrs. A. Carse and M'Kendrick, Secretaries of the Mechanics' Institute; Mr. Geo. Bell, Member of Committee; Mr. Pace, Chief Collector of Borough Rates; Mr. R. Lowry, railway goods' station; and Mr. Benson, Central Exchange News' Room,—all of Newcastle-on-Tyne. Should *Climaxodus* and *Janassa* be eventually classed as one genus, the order will then stand *Janassa bituminosa*, *J. imbricata*, *J. ovata*, and *J. vermiformis*—*J. linguæformis* being merely a synonym of *J. ovata*. Ashamed that, for the first time, I have to refute the imputation of untruthfulness,

I am,
Yours obediently,
T. P. Barkas, F.G.S.

Newcastle-on-Tyne,
Nov. 9, 1869.

[It is evident that, as the descriptions of Messrs. Atthey and Barkas appeared in print on the same day, there can be no question of priority of publication between them. The question really at issue is, whether Mr. Barkas's having "publicly named" the species, at a meeting of such a body as the Newcastle Mechanics' Institute, on the 28th of September 1868, gives him a priority over Mr. Atthey, whose *subsequently published paper* was read at a meeting of a recognized scientific society on the 9th of October following. We do not understand Messrs. Atthey and Hancock, in their last paper, to have cast any doubt upon Mr. Barkas's veracity; their statement seems to us simply to relate to the want of any recorded evidence, for the guidance of future palæontologists, of the species having been satisfactorily described by Mr. Barkas on the occasion to which he refers.]

On Exobasidium, *Woronin*. By H. Karsten.

Fusidium vaccinii, discovered in 1861 by Fuckel, and described and figured by him in the 'Botanische Zeitung' (p. 251, tab. 10. fig. 7), was made the subject of a thorough investigation by Woronin, who published his results, accompanied by good, characteristic figures, in the 'Bericht der Verhandl. der naturf. Gesellschaft in Freiburg' for 1867, p. 697. As Woronin found that the gonidia, which are at first unilocular, but afterwards (as indeed Fuckel figures them) multilocular, stand in fours (rarely in fives) on the summit of the clavate ends of mycelium-threads, which, standing in masses parallel to each other vertically, form a sort of hymenium, he thought justly that the fungus should be separated from the genus *Fusidium* and regarded as the type of a peculiar genus, *Exobasidium*; but he referred it incorrectly to a position among the Basidiomycetes, on account of its gonidia being placed upon clavate sterigmata. It seemed to me, at least from the other statements of the developmental history, that this arrangement could not be justified upon this ground alone; for I had recognized the mother cell of the

fungal fruit fecundated by copulation in *Agaricus campestris* and *A. vaginatus*, and at the same time demonstrated that the fruit of the Basidiomycetæ (just like those of the Lichens which contain their seeds in tubes [*Cœnogonium*], to which, according to recent observations, the Ascomycetæ approach, as indeed had been anticipated by me*) is the product of an act of copulation of two heterogeneous cells; and therefore it might justly be required of any one who was inclined to regard a stage in the development of a fungus, in opposition to the opinion of its discoverer who occupies a high scientific position, not as a gonidial, but as a fruit-form, that he should prove that the developmental form in question was the product of a process of fecundation, or, at least, that he should endeavour to render the evidence of this as little doubtful as possible. The necessity of this proof was not thought of by Woronin, who rather considered the basidial form of the gonidiophores sufficient to enable him to form a judgment as to the nature of the fungal organization in question.

As, however, the form of the gonidia is so variable in the Fungi, and in part simulates the fruit- and seed-formation in the Ascomycetæ and Hymenomycetæ, nothing can be ascertained from it as to the position of the species to which it belongs. This conviction induced me to make a fresh investigation of this fungus, which is widely diffused in the pine-forests of North Germany upon *Vaccinium Vitis Idæa*, and occurs near Berlin from May to September.

On the mycelium of the fungus growing in the leaf-tissue of the *Vaccinium*, I was unable to detect the presence of any copulatory organs; but it does not follow that I may not have overlooked them, and therefore this can be no proof that no act of copulation takes place upon it. On the other hand, I observed, in the gonidia described by Fuckel and Woronin, developmental phenomena which are by no means in favour of these being the seeds of a Basidiomycetan, as Woronin asserts when he describes their supports as the basidia of a Hymenomycetan.

I found that the gonidia, which with very rare exceptions occur in fours upon the summit of thick cylindrical branch-cells of the mycelium, and are supported upon short, thick, bristly peduncles, frequently become cellular, both when they remain upon their supports and can become further developed, and after being shaken off or withered. This is effected, in the first place, by the extension of two nuclear cells contained in them (and already observed by Woronin) until they touch each other in the middle of their mother cell, when they form a transverse septum; then in each of these two daughter cells two new cells are again produced in the same way, and extend themselves until two new transverse septa are again produced; at the same time the mother cell (the original gonidium), which was at first bent and somewhat inclined outwards, becomes slightly increased in size, acquires a more cylindrical form, and erects itself, so that all the four cells form a longitudinally divided cylin-

* Gesammelte Beiträge zur Anatomie und Physiologie der Pflanze, p. 341; Das Geschlechtsleben der Pflanze und die Parthenogenesis, 1860.

drical body as a continuation of its bearer. This basidiiform supporter likewise grows, and a transverse septum is produced also in it, which is sometimes followed in the lower part by a second. This is a behaviour not yet observed in the true basidia (the seed mother cells) of the Hymenomycetæ, unless the Tremellaceæ be excepted; but in these, again, the seeds have a totally different position, and indeed it still remains to be proved that they are truly seeds—that is to say, that these Tremellaceæ are truly fruits of Hymenomycetæ.

This development of septa in the gonidia is not all, however; when they are left to their quiet and undisturbed development, new pedicles are produced at the summit of the uppermost daughter cells of each of these four gonidia; and in these, again, a daughter cell is formed, which grows into a cylindrical gonidium, resembling the original gonidium, but more regularly elongated. These four gonidia of the second order usually soon apply themselves to each other again, and lengthen the column formed by their supporter. From the summit of these secondary gonidia (gonidium mother cells), similar gonidia then again sprout forth, which behave in the same way, often subsequently, before germination and whilst still connected with the parent organism, become chambered, but not unfrequently remain simple, and in many cases do not lay themselves together; so that the chain-like connexion of each series may be easily recognized. The development is not, however, completed by the formation of this simple chain upon the original basidium, but there is not unfrequently produced from the inferior gonidia, close to the primary links of the chain, and either soon after their complete development, or even before it, a second similar generation of gonidia; so that each of these series of gonidia represents a branched, and not a simple chain.

If with this phenomenon, which is just as unprecedented in the seeds of the Hymenomycetæ as it is generally known in the gonidial forms, we consider the cameration of the so-called basidia and the development of the entire plant beneath the epidermis of the living plant on which it subsists, without the recognition of any mother cell of the hymenium, such as I have demonstrated in the case of *Cœnogonium*, and such as likewise exists, so far as I know, in the Æcidiaceæ, Hymenomycetæ, and Ascomycetæ, these developmental phenomena certainly furnish no proof that this parasite belongs to the Basidiomycetæ; but still less do they characterize this developmental stage (which has been called *Exobasidium* as the fruit and its gonidia) as the seeds of a Hymenomycetan. It cannot, therefore, be referred to the Basidiomycetæ unconditionally until further investigations have shown that it (probably as a gonidial form) really belongs to a Basidiomycetan. The same doubt, with regard to the signification of the known organs of reproduction, which I have here raised in the case of *Exobasidium*, applies also to *Taphrina*, F. Tul. (*Exoascus*, Fuckel), which has, certainly with justice, been described by Woronin as a developmental stage analogous to *Exobasidium*. Both are to be regarded for the present as gonidial stages, and placed among the Coniomycetæ.—*Communicated by the Author.*

Polypterus Lapradei, sp. n., *and* Polypterus senegalus.
By F. Steindachner.

The author has discovered that in the two species of Ganoid fishes above mentioned external branchiæ occur when they are young. In his new species, *P. Lapradei*, the branchiæ persist in individuals 19 inches long. They consist of a long, flattened band, with fringed edges, very like the external branchiæ of the axolotls; there is a single one on each side behind the operculum, and it does not pass the posterior margin of the pectoral fin. In *P. senegalus* this transitory organ disappears sooner, and is no longer to be found in specimens measuring $3\frac{1}{2}$–4 inches in length. That these are respiratory organs has been proved by the anatomical investigations of Prof. Hyrtl.—Note by M. A. Duméril; *Comptes Rendus*, Oct. 18, 1869, p. 898.

Large Trees in Australia.

On this subject the government director of the Botanic Garden at Melbourne furnishes some interesting details, as follows:—"The marvellous height of some of the Australian (and especially the Victorian) trees has become the subject of closer investigation since of late (particularly through the miners' tracks) easier access has been afforded to the back gullies of our mountain-system. Some astounding data, supported by actual measurements, are now on record. The highest tree previously known was a Karri Eucalyptus (*Eucalyptus colossea*), measured by Mr. Pemberton Walcott, in one of the delightful glens of the Warren River, in Western Australia, where it rises to approximately 400 feet high. Into the hollow trunk of this Karri, three riders, with an additional pack-horse, could enter and turn in it without dismounting. At the desire of the writer of these pages (Dr. Muller), Mr. D. Bogle measured a fallen tree of *Eucalyptus amygdalina*, in the deep recesses of Daudenong (Victoria), and obtained for it the length of 420 feet, with proportionate width; while Mr. G. Klein took the measurement of a Eucalyptus on the Black Spur, ten miles distant from Healesville, 480 feet high. . . . . It is not at all likely that, in these isolated inquiries, chance has led to the really highest trees, which the most secluded and the least accessible spots may still conceal. It seems, however, almost beyond dispute that the trees of Australia rival in length, though evidently not in thickness, even the renowned forest giants of California, *Sequoia Wellingtonia*, the highest of which, as far as the writer is aware, rises, in their favourite haunts at the Sierra Nevada, to about 450 feet. . . Thus to Victorian trees the palm must be conceded for elevation."—*Mossman's Origin of the Seasons*, p. 367.

INDEX TO VOL. IV.

END OF THE FOURTH VOLUME.

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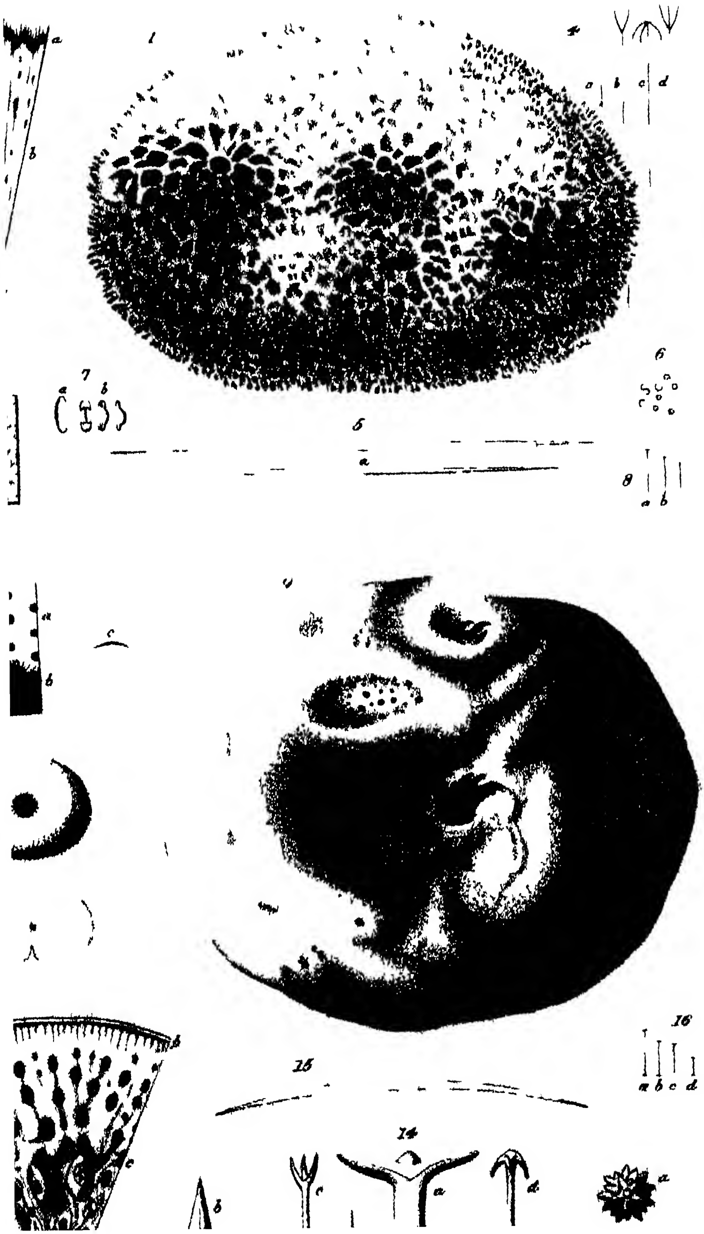

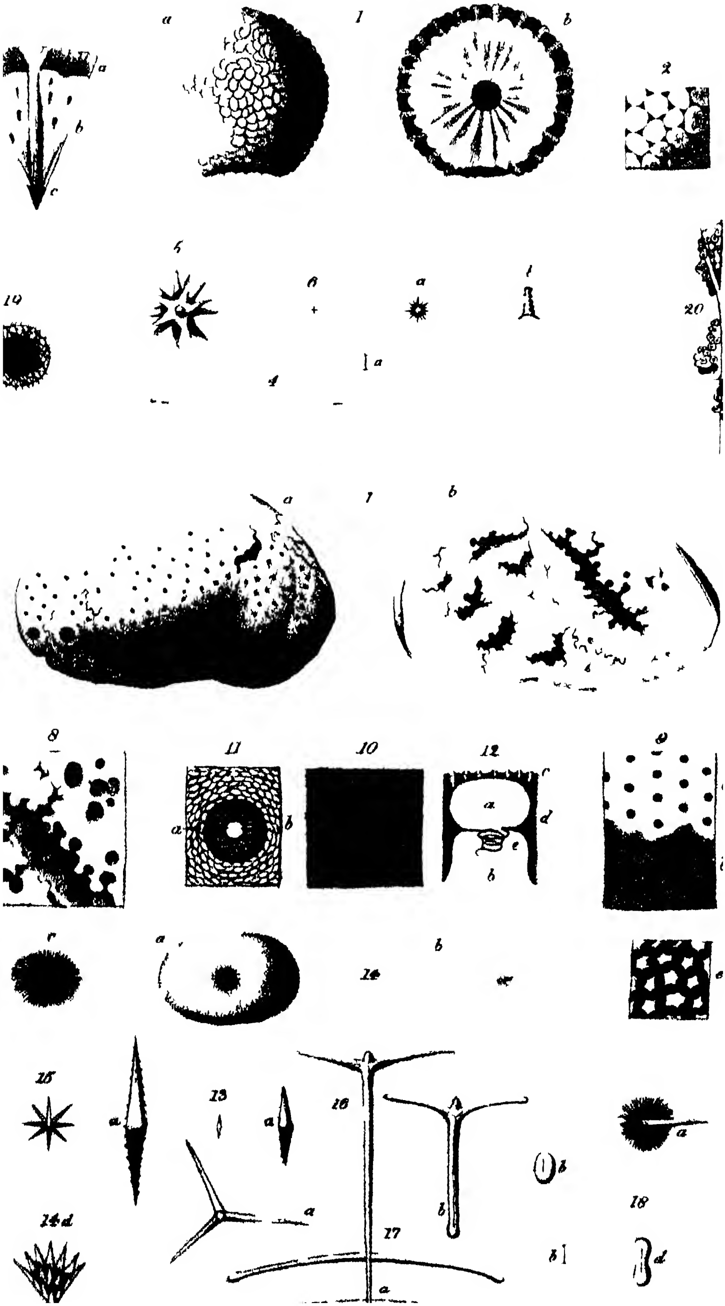

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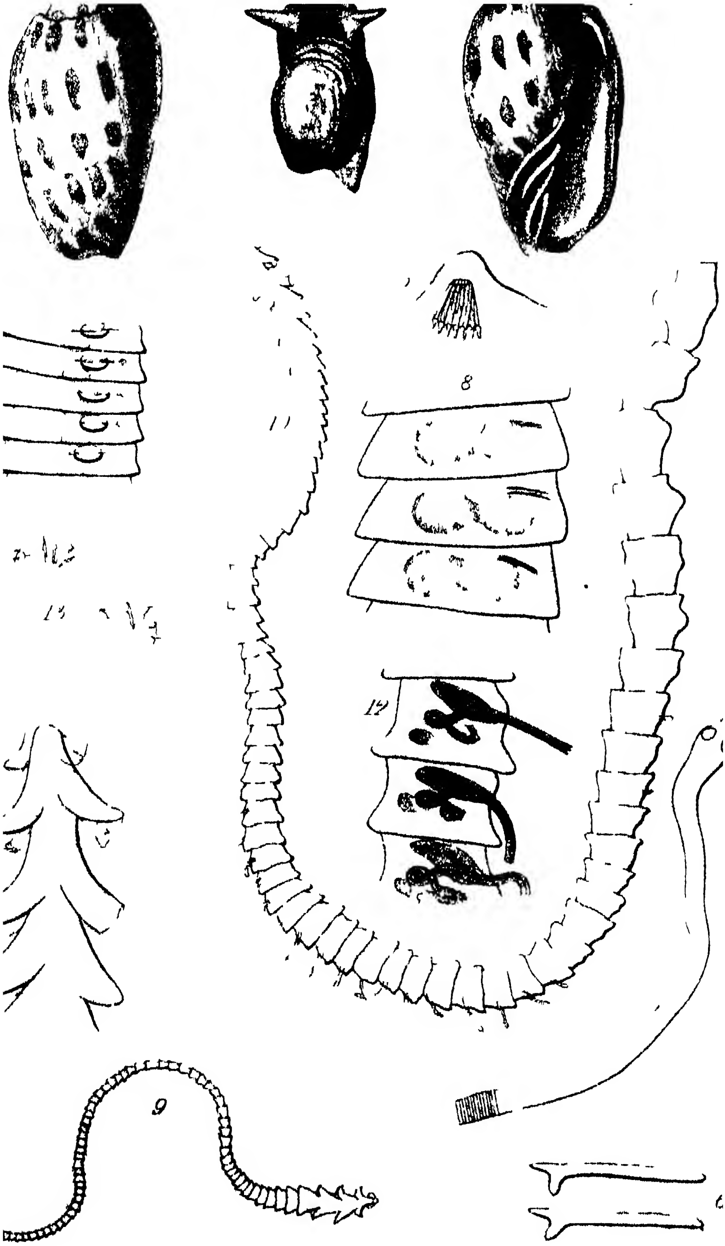

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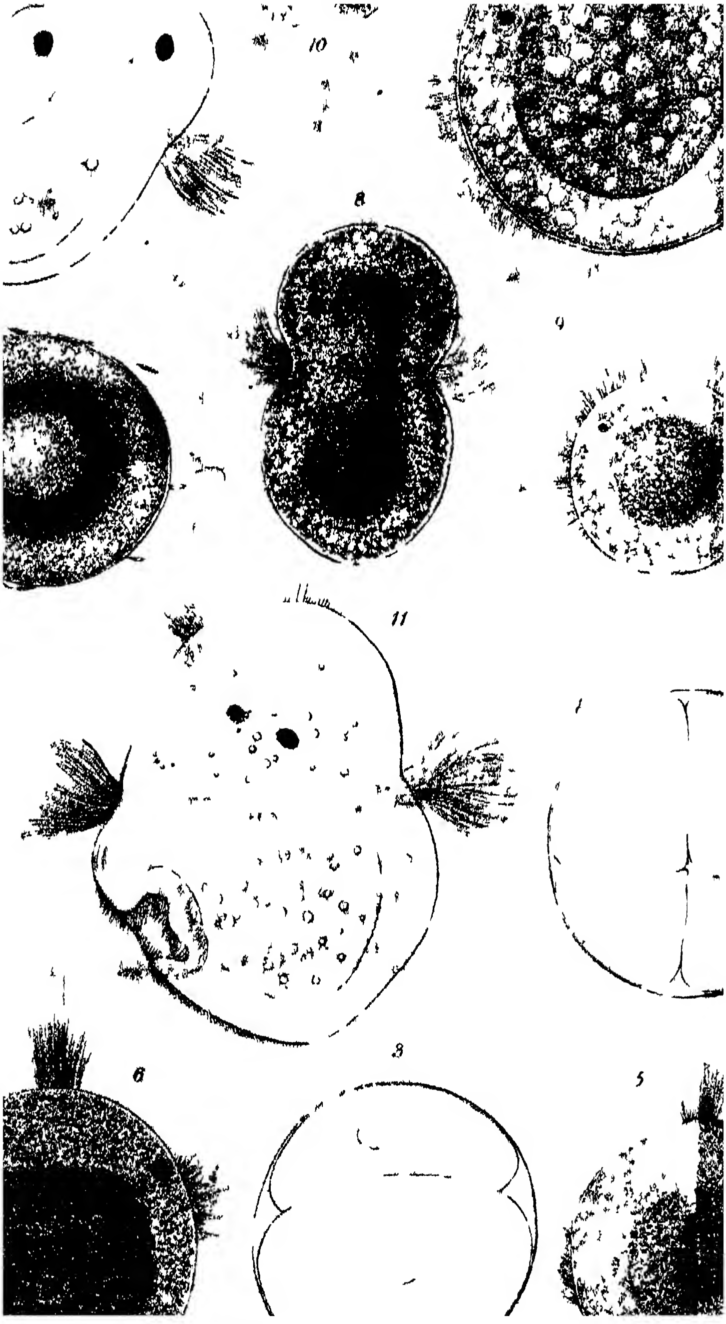
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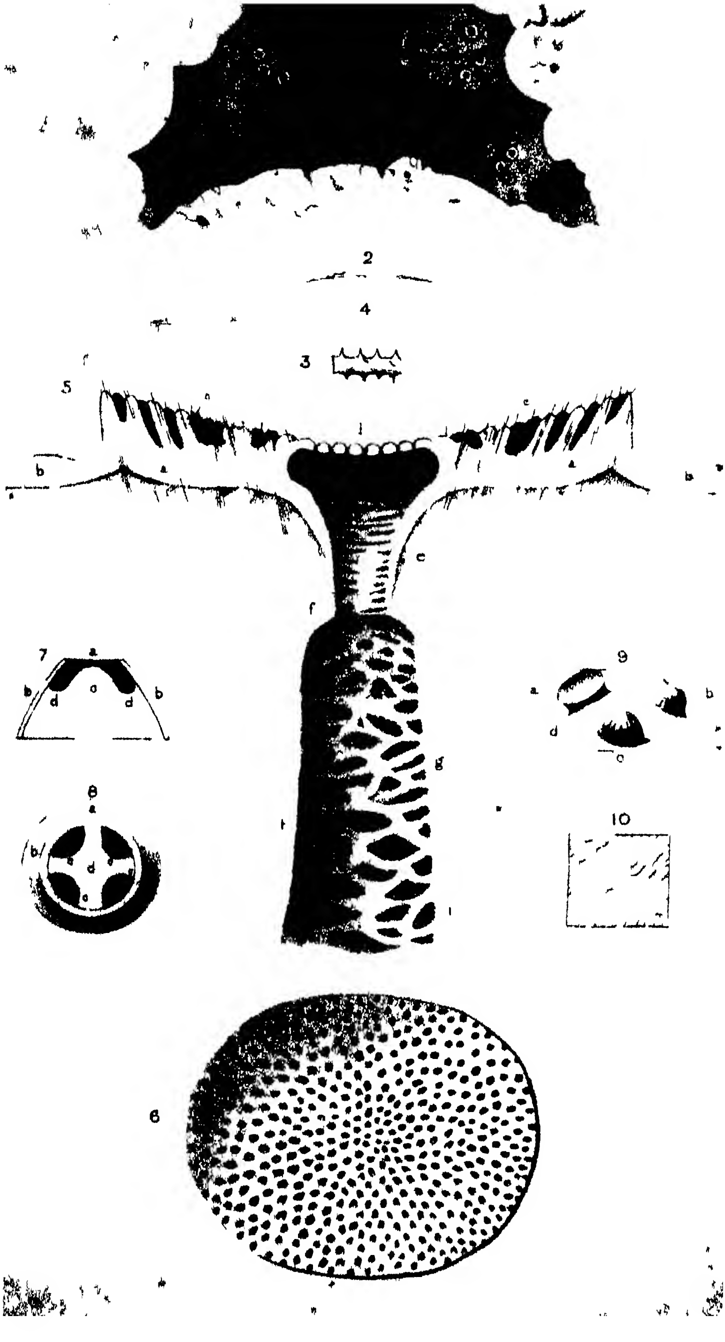

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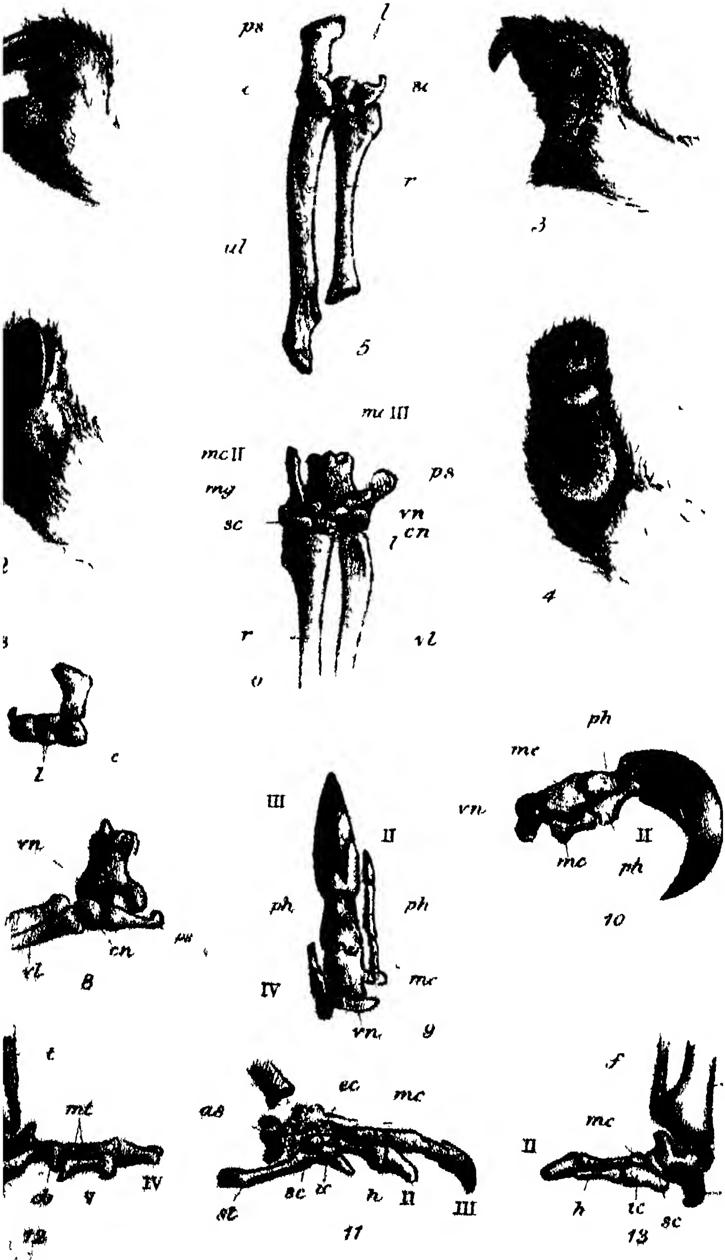
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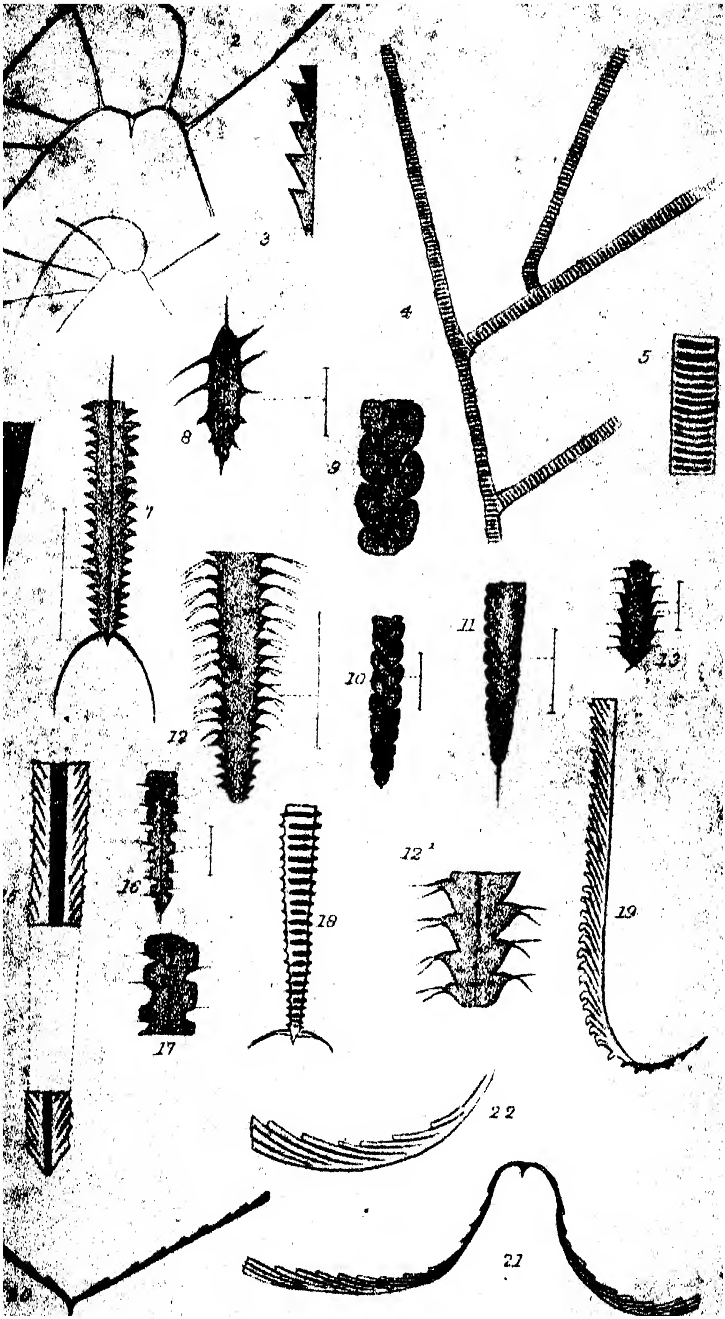
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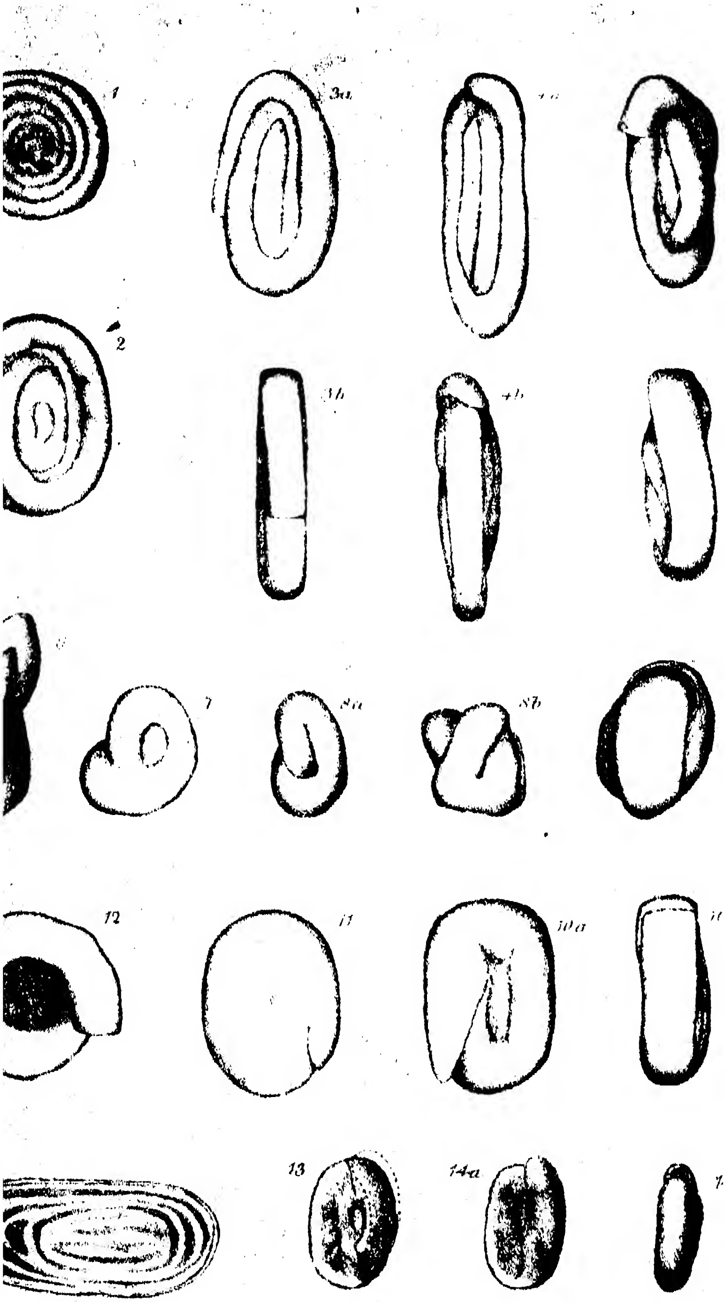
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12
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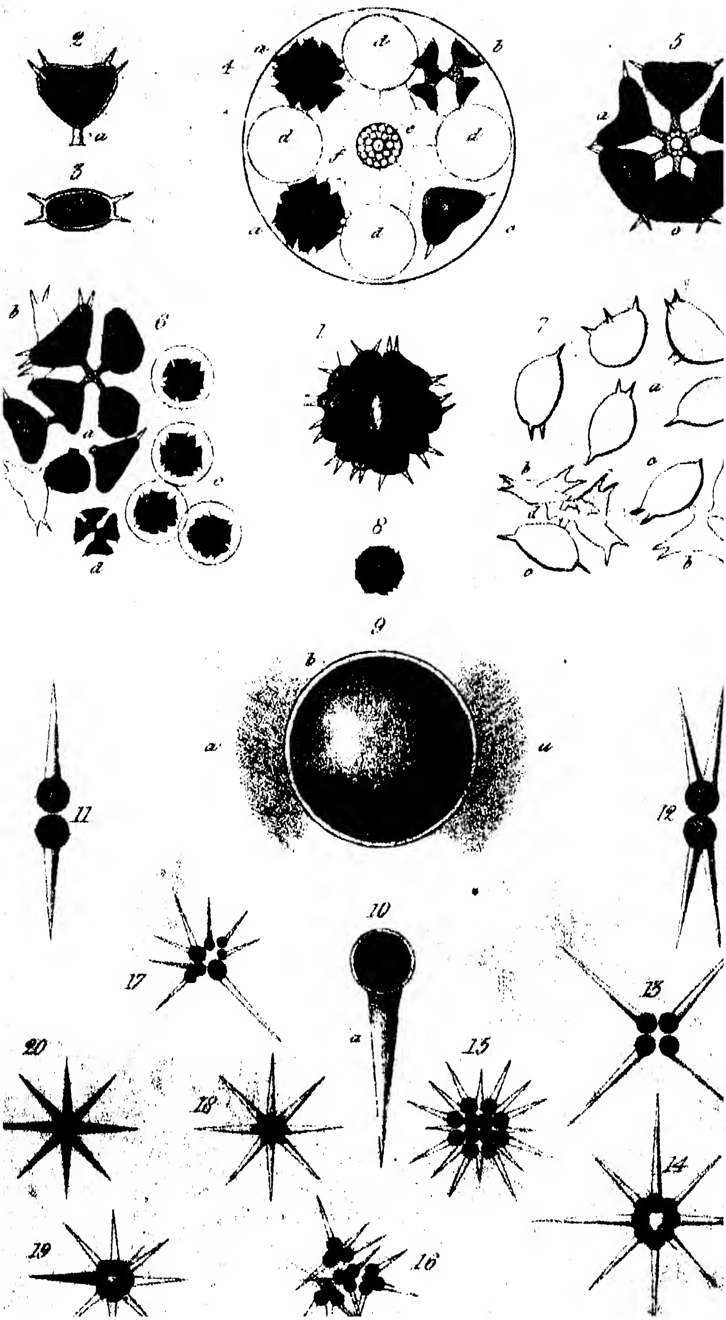
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